

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS AMERICA, INC.,
SAMSUNG ELECTRONICS CO., LTD.,
Petitioners,

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2024-01247

U.S. Patent No. 7,593,492

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,593,492**

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. STANDING.....	4
III. GROUNDS.....	4
IV. POSITA.....	5
V. BACKGROUND	5
A. Background of Technology.....	5
B. '492 patent.....	9
C. Prosecution History.....	11
D. Claim Construction.....	11
VI. SUMMARY OF PRIOR ART	11
A. Onggosanusi (Ex. 1005).....	11
B. Egnor (Ex. 1006)	13
VII. GROUNDS OF REJECTION	18
A. Ground 1: Claims 1-16 are Rendered Obvious by Onggosanusi in view of Egnor	18
1. Motivation to Combine	19
(a) Egnor's multi-user detectors	19
(b) Egnor's bank of decoders.....	21
(c) Egnor's iterative decoding	23
(d) Egnor's interleavers and deinterleavers.....	25
(e) Egnor's filter.....	27
(f) Analogous Art.....	28
2. 1pre: A hybrid Multi-User Detector System for processing received signals, comprising:	28
(a) 1a: a parameter estimator coupled to said received signals providing received data information;.....	32
(b) 1b: a multi-user detector decision unit coupled to said parameter estimator and said received signals;	

1c: at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit, said multi-user detector decision unit using decision criteria to determine a selected multi-user detector.....	34
(c) 1d: wherein said selected multi-user detector outputs a plurality of information streams, one stream corresponding to each of said received signals; and.....	37
(d) 1e: a bank of decoders coupled to said plurality of information streams, wherein said decoders output a plurality of improved information streams.	41
3. Claim 2: The System according to claim 1 wherein said plurality of improved information streams are fed back to said multi-user detector decision unit until a final condition is reached and said bank of decoders output a final data stream.....	42
4. Claim 3: The System according to claim 1 wherein said design criteria is based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.	43
5. Claim 4: The System according to claim 3 wherein said threshold is dynamically changeable.....	44
6. Claim 5: The System according to claim 1 wherein said at least two multiuser detectors are selected from the group consisting of: M-algorithm, sphere decoder, T-algorithm, FANO, reduced state Viterbi, Maximum Likelihood, matched filter, minimum mean squared error (MMSE), decorrelator, and combinations thereof.	45
7. Claim 6: The System according to claim 1, further comprising an interleaver unit and a deinterleaver unit coupled between said bank of decoders and said multi-user detectors.....	45

8. Claim 7: The System according to claim 2, wherein said final condition is determined by one of a fixed number of iterations and an allowable performance level.....45
9. Claim 8: The System according to claim 1, further comprising a filter unit coupled to said received signals, wherein said filter unit is coupled to said multi-user detector decision unit. 46
10. Claim 9: The System according to claim 1, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream.....46
11. 10pre: A hybrid receiver for processing a plurality of received signals, said receiver comprising: 46
 - (a) 10a: a parameter estimation unit coupled to said received signals, wherein said parameter estimation unit extracts received signal information;.....47
 - (b) 10b: a multi-user detector decision unit coupled to said parameter estimator and said received signals, wherein said multi-user detector decision unit selects a multi-user detector based upon at least one threshold;.....47
 - (c) 10c: a low complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said low complexity multi-user detector outputs a plurality of low complexity processed information streams; 10d: a medium complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said medium complexity multi-user detector outputs a plurality of medium complexity processed information streams; 10e: a high complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said high complexity multi-user detector outputs a plurality of high complexity processed information streams; and.....47
 - (d) 10f: a bank of decoders coupled to said plurality of low complexity processed information streams, said

	plurality of medium complexity processed information streams, and said plurality of high complexity processed information streams, wherein said decoders output a plurality of refined information streams.	49
12.	Claim 11: The hybrid receiver according to claim 10, further comprising a front end section coupled to said received signals and to said received signal information which filters said received signals.....	49
13.	Claim 12: The hybrid receiver according to claim 10, wherein said plurality of refined information streams are fed back to said multi-user detector decision unit for iterative processing until a final condition is reached and said bank of error correction decoders output a final plurality of bit streams.	49
14.	Claim 13: The hybrid receiver according to claim 10, wherein said multi-user detector decision unit makes a selection determined by design criteria based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.	49
15.	Claim 14: The hybrid receiver according to claim 10, wherein said threshold is changeable.	50
16.	Claim 15: The hybrid receiver according to claim 12, wherein said final condition is one of a fixed number of iterations and an allowable performance level.....	50
17.	Claim 16: The hybrid receiver according to claim 10, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream.	50
B.	Ground 2: Claims 17-18 are Rendered Obvious by Egnor in view of Onggosanusi	50
1.	Motivation to Combine	51
2.	17pre: A method for processing signals from multiple users with raw digitized data, comprising:	53

(a)	17a: performing parameter estimation of said raw digitized data;	53
(b)	17b: grabbing a window of bits from said raw digitized data;	54
(c)	17c: subtracting any known bits from said window of bits;.....	54
(d)	17d: selecting a multi-user detector;.....	54
(e)	17e: estimating unknown bits from said window of bits using said multi-user detector;.....	55
(f)	17f: incrementing to a next window of bits;	56
(g)	17g: repeating said steps of subtracting, selecting, estimating and incrementing until there are no more windows and outputting a set of symbol estimates.	56
3.	Claim 18: The method according to claim 17, wherein said multi-user detector is selectable from the group consisting of high complexity multi-user detectors, medium complexity multi-user detectors, low complexity multi-user detectors and matched filters.	56
VIII.	DISCRETIONARY DENIAL UNDER <i>FINTIV</i> IS NOT WARRANTED.....	57
IX.	MANDATORY NOTICES AND FEES	60
A.	Real Party-In-Interest.....	60
B.	Related Matters.....	60
C.	Counsel and Service Information	61
D.	Payment of Fees.....	62
X.	CONCLUSION	63

EXHIBIT LIST

Ex.	Description
1001	U.S. Patent No. 7,593,492 (“’492 patent”)
1002	Prosecution History for 7,593,492
1003	Declaration of Dr. Paul Min
1004	<i>Curriculum Vitae</i> of Dr. Paul Min
1005	U.S. Patent Pub. No. 2006/0018410A1 (“Onggosanusi”)
1006	U.S. Patent Pub. No. 2005/0053173A1 (“Egnor”)
1007	Sergio Verdu, “Multiuser Detection,” Cambridge University Press (1998) (“Verdu”)
1008	Infringement Contentions – Chart for U.S. Pat. No. 7,593,492
1009	Lathi, Modern Digital and Analog Communication Systems, Third Edition, Oxford University Press (1998)
1010	U.S. Pat. No. 6,947,505

LIST OF CHALLENGED CLAIMS

Claim	Limitation
1pre	A hybrid Multi-User Detector System for processing received signals, comprising:
1a	a parameter estimator coupled to said received signals providing received data information;
1b	a multi-user detector decision unit coupled to said parameter estimator and said received signals;
1c	at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit, said multi-user detector decision unit using decision criteria to determine a selected multi-user detector,
1d	wherein said selected multi-user detector outputs a plurality of information streams, one stream corresponding to each of said received signals; and
1e	a bank of decoders coupled to said plurality of information streams, wherein said decoders output a plurality of improved information streams.
2	The System according to claim 1 wherein said plurality of improved information streams are fed back to said multi-user detector decision unit until a final condition is reached and said bank of decoders output a final data stream.
3	The System according to claim 1 wherein said design criteria is based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.

Claim	Limitation
4	The System according to claim 3 wherein said threshold is dynamically changeable.
5	The System according to claim 1 wherein said at least two multiuser detectors are selected from the group consisting of: M-algorithm, sphere decoder, T-algorithm, FANO, reduced state Viterbi, Maximum Likelihood, matched filter, minimum mean squared error (MMSE), decorrelator, and combinations thereof.
6	The System according to claim 1, further comprising an interleaver unit and a deinterleaver unit coupled between said bank of decoders and said multi-user detectors.
7	The System according to claim 2, wherein said final condition is determined by one of a fixed number of iterations and an allowable performance level.
8	The System according to claim 1, further comprising a filter unit coupled to said received signals, wherein said filter unit is coupled to said multi-user detector decision unit.
9	The System according to claim 1, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream.

Claim	Limitation
10pre	A hybrid receiver for processing a plurality of received signals, said receiver comprising:
10a	a parameter estimation unit coupled to said received signals, wherein said parameter estimation unit extracts received signal information;
10b	a multi-user detector decision unit coupled to said parameter estimator and said received signals, wherein said multi-user detector decision unit selects a multi-user detector based upon at least one threshold;
10c	a low complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said low complexity multi-user detector outputs a plurality of low complexity processed information streams;
10d	a medium complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said medium complexity multi-user detector outputs a plurality of medium complexity processed information streams;
10e	a high complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said high complexity multi-user detector outputs a plurality of high complexity processed information streams; and
10f	a bank of decoders coupled to said plurality of low complexity processed information streams, said plurality of medium complexity processed information streams, and said plurality of high complexity processed information streams, wherein said decoders output a plurality of refined information streams.
11	The hybrid receiver according to claim 10, further comprising a front end section coupled to said received signals and to said received signal information which filters said received signals.

Claim	Limitation
12	The hybrid receiver according to claim 10, wherein said plurality of refined information streams are fed back to said multi-user detector decision unit for iterative processing until a final condition is reached and said bank of error correction decoders output a final plurality of bit streams.
13	The hybrid receiver according to claim 10, wherein said multi-user detector decision unit makes a selection determined by design criteria based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.
14	The hybrid receiver according to claim 10, wherein said threshold is changeable.
15	The hybrid receiver according to claim 12, wherein said final condition is one of a fixed number of iterations and an allowable performance level.
16	The hybrid receiver according to claim 10, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream.
17pre	A method for processing signals from multiple users with raw digitized data, comprising:

Claim	Limitation
17a	performing parameter estimation of said raw digitized data;
17b	grabbing a window of bits from said raw digitized data;
17c	subtracting any known bits from said window of bits;
17d	selecting a multi-user detector;
17e	estimating unknown bits from said window of bits using said multi-user detector;
17f	incrementing to a next window of bits;
17g	repeating said steps of subtracting, selecting, estimating and incrementing until there are no more windows and outputting a set of symbol estimates.
18	The method according to claim 17, wherein said multi-user detector is selectable from the group consisting of high complexity multi-user detectors, medium complexity multi-user detectors, low complexity multi-user detectors and matched filters.

I. INTRODUCTION

Wireless communication technologies, such as the cellular technologies TDMA, FDMA and CDMA, incorporate methodologies for dividing a transmission into multiple parts, with each part dedicated to transmitting information to a different user. TDMA (Time-Division Multiple Access) divides a transmission into various time slots, with each time slot dedicated to transmitting a particular user's data, FDMA (Frequency-Division Multiple Access) divides a transmission into different frequency ranges, and CDMA (Code-Division Multiple Access) divides a transmission into codes. Such techniques allow for more efficient use of bandwidth.

However, all of these techniques introduce both noise and interference into the transmission, particularly where multiple signals are transmitted over a single channel. Multiuser detection (MUD) is a solution to this problem. MUD techniques allow detection of a transmission signal's constituent parts even if there are high levels of noise and interference.

At the time of the '492 patent in 2006, there were several well-known MUD algorithms, such as maximum likelihood sequence estimation and linear minimum mean squared error (MMSE). Different algorithms have different levels of complexity (and thus power usage)—higher interference in a transmission requires higher complexity in the MUD algorithm.

As the '492 patent admits, MUDs were well-known in the prior art; indeed, the patent does not purport to invent a new MUD algorithm. Instead, the '492 patent purports to introduce the selection of a particular MUD algorithm depending on a “parameter estimate,” such as the estimate of channel conditions for the transmission signals. Notably, the '492 patent also admits parameter estimation was well-known, meaning the alleged point of novelty is narrow—the ***selection*** of a particular MUD, and nothing more. By performing such a selection, a low complexity detector can be selected for signals with low interference and noise, and a high complexity detector can be selected for signals that require it. Figure 2 depicts an embodiment of this system, where “MUD decision unit 220” selects from a number of multi-user detectors based on a parameter estimation.

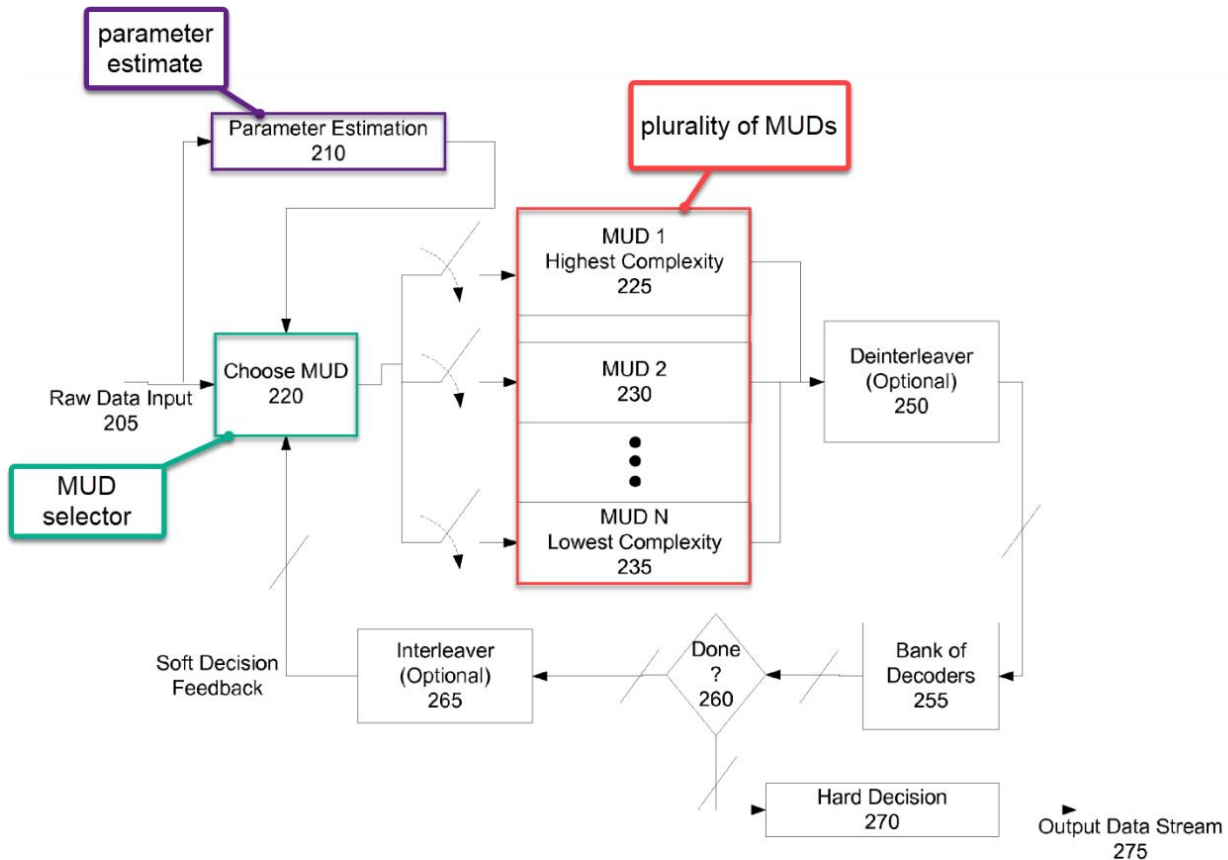
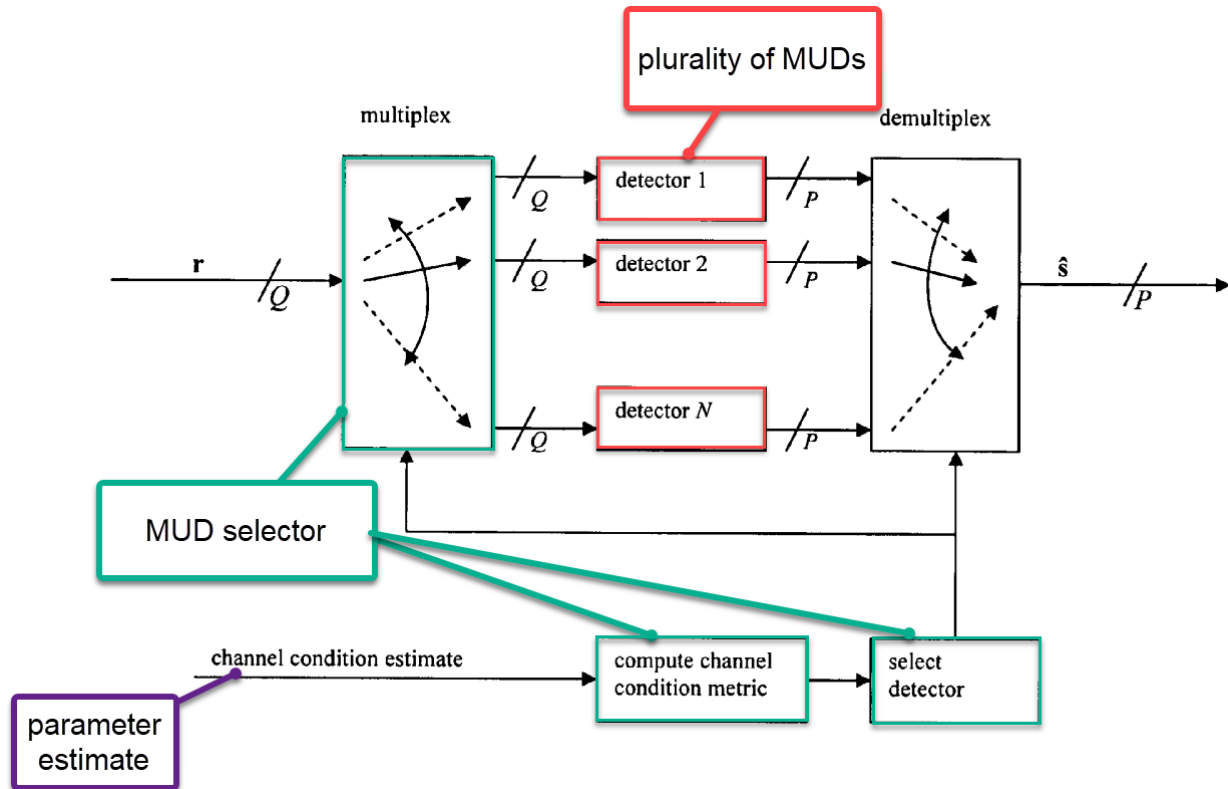


Figure 2

However, by the patent's filing date in 2006, even this allegedly novel selection technique was already well-known. For example, Onggosanusi (Ex. 1005), a patent application originally filed by Texas Instruments in 2004, discloses a plurality of multi-user detectors of varying complexity (from the highly complex joint maximum likelihood detector to the low complexity MRC detector) based on a channel estimate, *i.e.* the correlation/interference of the received signals. This is shown in Figure 2 of Onggosanusi, annotated below:



The '492 patent further recites well-known components of a receiver for processing signals, such as a bank of decoders, iterative decoding, interleavers, and filters. Each of these well-known components were disclosed by Egnor, and a POSITA would have found it obvious to combine the two references.

II. STANDING

Petitioners certify the '492 patent is available for *inter partes* review and they are not estopped.

III. GROUNDS

Petitioners present the following grounds of invalidity:

Ground	Basis	Reference(s)	Claims
1	§103	Onggosanusi, Egnor	1-16
2	§103	Egnor, Onggosanusi	17-18

Claims 1 and 17 relate to different subject matter, which is why Petitioner presents the above grounds. Onggosanusi discloses a system for selecting among a plurality of detectors of varying complexity based on a channel estimation of received signals, and would be obvious to combine with Egnor's bank of decoders to render obvious Claims 1-16. Ex. 1003, ¶71. Claim 17, however, is quite different from claim 1, reciting iterative multi-user detection on sliding windows of bits, where each window involves selecting a multi-user detector. Egnor discloses such a windowing method, and would be obvious to combine with Onggosanusi's selection of a detector. Ex. 1003, ¶72.

IV. POSITA

A POSITA at the time of the '492 patent had at least a bachelor's in EE/CE/CS, physics, or equivalent, and two years of experience with cellular telecommunications, radio-access network architectures, protocols and signal propagation in wireless networks. Ex. 1003, ¶¶49-51. More education can supplement practical experience and vice versa. *Id.* Petitioners' expert exceeded this by the priority date. *Id.*

V. BACKGROUND

A. Background of Technology

When transmitting information over a wireless telecommunication system, information is first converted into a **baseband signal**. Ex. 1009, 10. Baseband

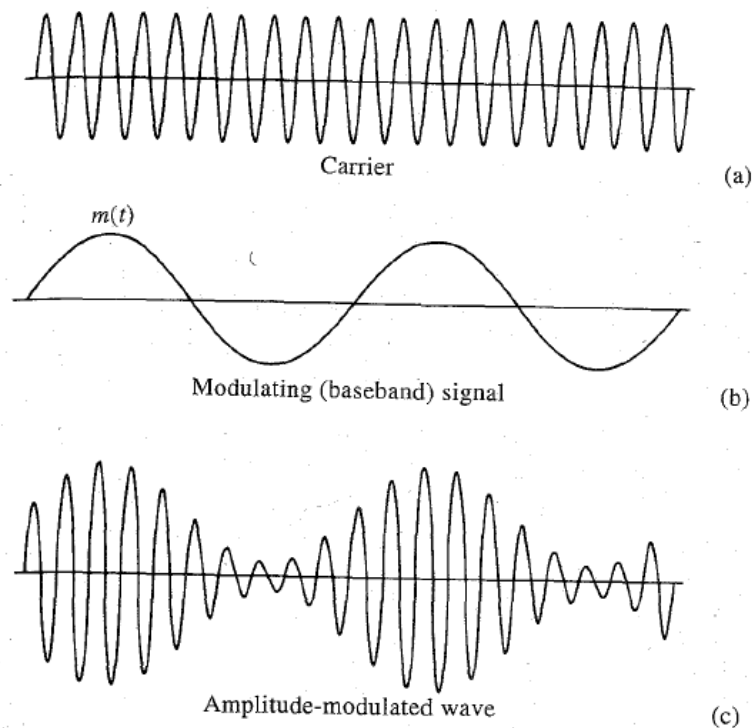
signals operate at low frequencies. For example, for telephony, the audio baseband is 0 to 3.5 KHz. *Id.*, 85. For digital data, baseband depends on the “ R_b pulses for second,” and is 0 to R_b Hz. *Id.* Because “baseband signals have sizable power at low frequencies,” they are “suitable for communications over a pair of wires, coaxial cables, or optical fibers.” *Id.*; Ex. 1003, ¶¶33-34.

However, wirelessly transmitting a baseband signal is usually not practical because the low frequencies mean the signal has a very long wavelength. For example, AM radio, which operates at 500 kHz to 1600 kHz, has wavelengths of 187.5 to 600 meters. By contrast, FM radio, which operates at 100 MHz, has a wavelength of about 3 meters. Ex. 1003, ¶35.

One problem with long wavelengths is that they require very large antennas to transmit. Signals with long wavelengths may also have trouble entering smaller areas—for example, AM radio does not work in tunnels because the wavelengths are too long. Finally, baseband frequencies are much more susceptible to noise, interference, and distortion from the environment—such as audible noise and electricity. Ex. 1003, ¶36.

As a result, baseband signals are usually converted to much higher frequencies (*e.g.*, radio frequencies) using a process called ***modulation***. Ex. 1009, 15. Modulation is the process of taking a carrier wave (also called a carrier frequency) at the desired frequency and modulating one of its parameters (*e.g.*, amplitude,

frequency, or phase) so that it carries the information being transmitted. *Id.* For example, in amplitude modulation, the carrier frequency is a high-frequency wave (for example, 600 kHz), and its amplitude is modified according to the baseband signal (which may have a center of 10 kHz), resulting in an amplitude-modulated wave (figure (c)). *Id.*, 15-16; Ex. 1003, ¶37.



Another issue with baseband signals is that they cannot be transmitted simultaneously because they “would interfere with each other.” *Id.*, 16. However, this can be solved by dividing the signal into components. For example, in FDMA, different carrier frequencies are modulated with different signals, and as long as “the various carrier frequencies are chosen sufficiently far apart in frequency,” they will not interfere with each other. *Id.* This allows for “transmitting several signals

simultaneously,” and thus allows for multiple users to share the same frequency band. *Id.*; Ex. 1003, ¶38.

CDMA also allows users to share bandwidth. However, instead of allocating a particular frequency range to a user, CDMA uses codes for each user to modulate the signal. Each code is orthogonal to another user’s code and thus minimizes interference. Ex. 1003, ¶39.

It should be noted that FDMA, TDMA, CDMA are **multiaccess** techniques that make use of **multiplexing**, which allows for multiple data streams to be transmitted simultaneously. However, “multiplexing” should not be confused with “multiaccess,” although those terms are sometimes “used interchangeably.” Ex. 1007, 18. The primary difference is that “multiaccess usually refers to situations where the message sources are not collocated and/or operate autonomously.” *Id.* In a multiaccess channel, the sources “are referred to as *users*,” and therefore the signal is a multiuser signal. *Id.* By contrast, multiplexing is a more general technique that does not necessarily involve multiaccess—for example, sometimes a MIMO signal is transmitted by a single source and generally does not involve multiple users and would therefore not be multiaccess even if the signal is multiplexed. Ex. 1003, ¶40.

Regardless, even when multiplexing and/or multiaccess techniques are used, interference and noise are nevertheless almost always present with any transmission channel. Ex. 1003, ¶41. This can create challenges in detecting the various user

signals within a single channel, because interference makes it difficult to differentiate one user's transmission signal from another user's transmission signal. As one of the prior art references, Onggosanusi, explains, CDMA systems have “frequency-selective channels which cause MUI (multi-user interference) as a result of the loss of orthogonality between spreading codes.” Ex. 1005 at ¶19.

Before the '492 patent, there were a number of algorithms for performing multi-user detection, and Onggosanusi provides an explanation for some of these algorithms. *Id.* at ¶¶22-29. Onggosanusi notes that these algorithms have different levels of complexity, with more complex algorithms like “joint ML detector” having better performance but higher power requirements, whereas a low complexity algorithm like “maximum ratio combining (MRC)” cannot accommodate interference at all. *Id.* at ¶¶30-34. However, Onggosanusi notes that in a low interference channel, both MRC and joint ML have the same performance—but as signals become more correlated (*i.e.* have higher interference), “the performance difference between the ML detector and a linear detector becomes large.” *Id.* at ¶35; Ex. 1003, ¶42.

B. '492 patent

The '492 patent notes that it was well-known to allow for increased demand in data for wireless signals, “multiple users [can now] access the same communications medium to transmit or receive information.” Ex. 1001, 1:32-33.

To accommodate such signals, “Advanced receiver processing techniques cover several areas, namely interference suppression (also called Multi-User Detection or MUD), multipath combining and space-time processing, equalization, and channel estimation.” *Id.*, 1:36-40; Ex. 1003, ¶43.

The '492 patent notes there are different methods for MUD of varying complexity. For high complexity, there are “maximum likelihood MUD, maximum likelihood sequence estimator for multiple interfering users, successive interference cancellation, TurboMUD or iterative MUD, and various linear algebra based multi-user detectors.” Ex. 1001, 5:14-18. For “suboptimal multiuser detectors that are less computationally complex” that were known, there are “linear detectors, includes decorrelators, minimum mean square error or MMSE detectors, and zero-forcing block linear equalizers.” *Id.*, 5:25-29; Ex. 1003, ¶44.

The '492 patent notes that with wireless devices, “the amount of processing within the device is limited, directly limiting the amount of computational complexity that is allowed.” Ex. 1001, 6:56-58. Thus, while the '492 patent admits MUDs of varying complexity were known, the '492 patent purports to introduce a system for selecting among a plurality of MUDs of varying complexity. However, as explained below, the selection of a plurality of MUDs was known in the prior art. Ex. 1003, ¶45.

C. Prosecution History

The '492 patent's application was filed on September 15, 2006 and did not claim priority to any other application. The examiner did not issue any office action rejecting or objecting to the claims and on July 30, 2009, the patent was issued a notice of allowance. In the notice of allowance, the examiner simply noted that "US patents Nos. 7,110,439; 7,340,281; 7,133,433 teach a multi-user detector." Ex. 1002, 31; Ex. 1003, ¶46.

D. Claim Construction

Unless otherwise indicated, and for this proceeding only, the claim terms should be given their plain and ordinary meaning under *Phillips*. Ex. 1003, ¶¶52-53.

VI. SUMMARY OF PRIOR ART

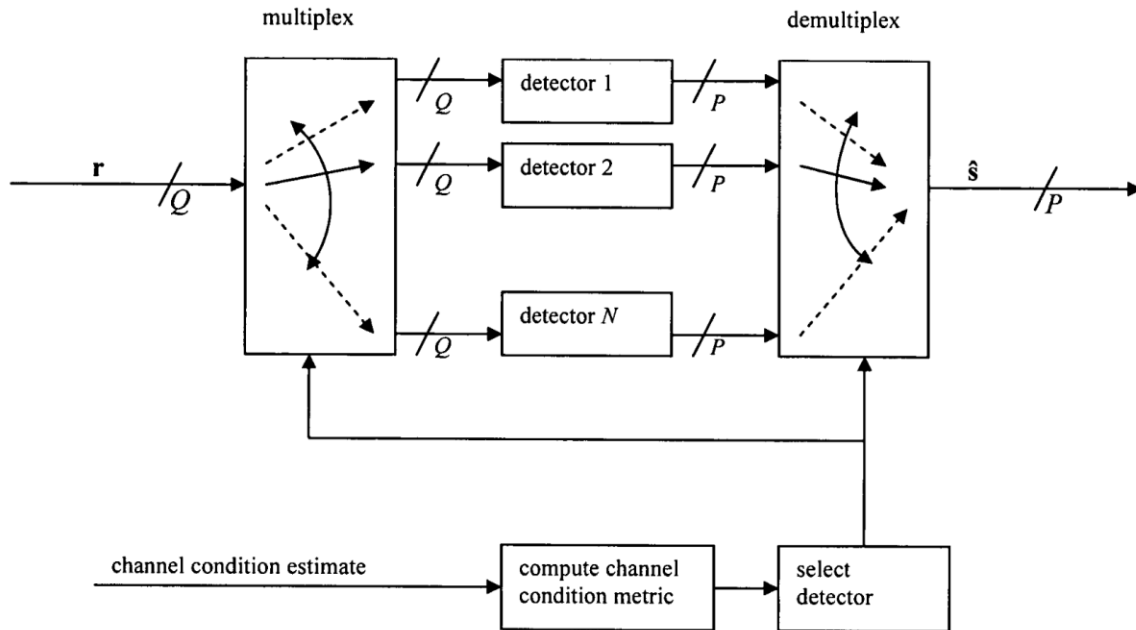
A. Onggosanusi (Ex. 1005)

U.S. Pat. Pub. No. 2006/0018410A1 was filed on July 26, 2004 and published on January 26, 2006. It is therefore prior art under pre-AIA 35 U.S.C. § 102(a) and 102(e). Ex. 1003, ¶¶55-59.

Onggosanusi describes its invention as follows: "In a wireless MIMO system, a multimode detector selects detection mode by channel estimation: ill-conditioned channels trigger use of high performance detection, whereas well-behaved channels lead to low complexity detection. Detection modes typically include maximum

likelihood, minimum mean squared error, zero forcing, and so forth.” Ex. 1005 at Abstract.

Figure 2 provides a block diagram of Onggosanusi’s system, where a selector chooses among a plurality of detectors based on a channel condition estimate.



Specifically, Onggosanusi discloses a “channel estimation, H ” which can be inputted into a function “ $f(H)$ ” to indicate whether “the channel is ‘well-behaved’” or “ill-conditioned.” Ex. 1005, ¶36. H in particular is “the $Q \times P$ channel matrix of attenuations and phase shifts” of the “baseband received signal” and “may be estimated using known (pilot) symbols.” *Id.*, ¶14. Onggosanusi further describes that $H = [h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p th data source to the receiver,” thus disclosing that the estimate is based on received signals providing received data information. *Id.*

Onggosanusi also teaches that “the preferred embodiment detector computes a channel metric $f(H)$, and based on $f(H)$ selects one of the N detectors by setting the multiplexer and demultiplexer.” *Id.*, ¶36. Onggosanusi discloses several detectors of varying complexity, such as:

- “1. joint ML detector: best performance, highest complexity
2. iterative detectors (IZF/IMMSE)
3. linear detectors (LZF/LMMSE)
4. maximum ratio combining (MRC) detector: worst performance (not interference resistant in general), lowest complexity.”

Id., ¶¶31-34.

B. Egnor (Ex. 1006)

U.S. Pat. Pub. No. 2005/0053173A1 was filed on September 10, 2003 and published on March 10, 2005. Ex. 1003, ¶¶60-64. It is therefore prior art under pre-AIA 35 U.S.C. § 102(b). Egnor is a patent owned by Patent Owner, but does not appear to have been originally assigned to Patent Owner. The '492 patent and Egnor do not share any inventors.

Egnor discloses a prior art MUD system in which “[t]he bit streams from [a] MUD [multi-user decoder] are passed to a bank of error correction decoder units 185.” Ex. 1006, ¶59. Egnor also describes iterative decoding, where “[s]oft outputs for each bit of each user from the bank of decoders 185 is *fed back to the multiuser*

detector 180 for each iteration, one stream of outputs for each interfering user present in the received signal.” Ex. 1006, ¶60.

Finally, the purported invention of Egnor was to use a windowing technique to pipeline the transmission through a series of MUD processors and decoders. *See, e.g., id.*, ¶¶77-84. This is depicted in Figure 5 below.

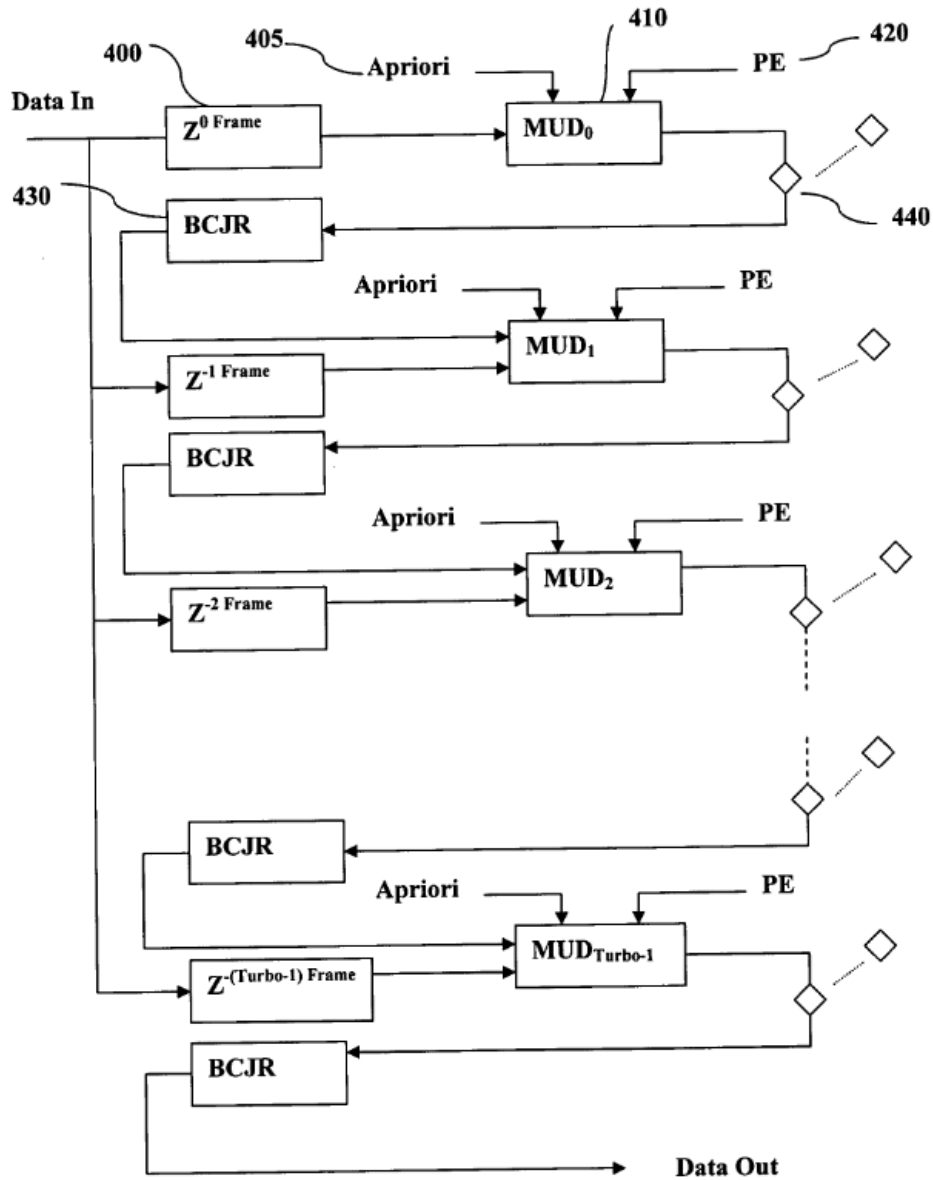


Figure 5

Figure 5 depicts a sequential series of MUDs (MUD₀, MUD₁, MUD₂, etc.), with each MUD processor “coupled to some form of parameter estimator 420 to obtain signal information for processing the data” and “coupled to decoders 430, such as the BCJR decoders, used in this example for decoding the completed frames

of data.” *Id.*, ¶79. An initial window of data is received by MUD₀, which “processes the partial frame of data within the processing window” and after completion, sends the processed data to “a decoding algorithm such as BCJR” which “provides the input to the next stage, MUD₁.” *Id.*, ¶80. This process continues through the sequence of MUD processors “until the last stage at which point the output from the BCJR is the output values of the system, Data Out. The Data Out is the symbol stream of improved and processed data.” *Id.*

Egnor further discloses that there were “various multiuser detectors known in the art” which are “detailed in the well-known text ‘Multiuser Detection’ by Sergio Verdu.” Ex. 1006, ¶9. Egnor incorporates by reference the Verdu text, because it describes “with detailed particularity what specific material it incorporates and clearly indicates where that material is found in the various documents,” specifically that it is incorporating by reference the Verdu text and its discussion of multiuser detectors. *Advanced Display Systems, Inc. v. Kent State University*, 212 F.3d 1272, 1282 (Fed. Cir. 2000); Ex. 1003, ¶64.

Alternatively, a POSITA would have considered it obvious to combine Egnor with Verdu, because Egnor instructs a POSITA to refer to Verdu for details about the multiuser detection algorithms that were known at the time. Ex. 1003, ¶64. A POSITA would have been motivated to incorporate Verdu’s teachings in order to give effect to Egnor’s teachings of various multiuser detectors using algorithms that

Egnor expressly teaches are disclosed in Verdu. *Id.* A POSITA would also be motivated to incorporate any other teachings in Verdu that involved multiuser detection. *Id.* And a POSITA would have reasonably expected the combination to succeed, since Verdu describes multiuser detection algorithms that Egnor expressly uses. *Id.*

Exhibit 1007 (“Verdu”) is a copy of this text and, according to its copyright page, was published in 1998 by Cambridge University Press. Ex. 1007, 3.

Dr. Min testifies that he is familiar with the Verdu text and agrees with the description in Egnor that it is widely known. Ex. 1003, ¶¶65-68. Dr. Min personally attests that Verdu was available before the earliest filing date in 2006 and describes well-known multiuser detection techniques. *Id.* Dr. Min further testifies that, because Cambridge University Press is a well-known publisher of scientific publications, a POSITA would have considered that the publication date listed on the face of the publication to be a reliable indicator of the date of its public availability. Dr. Min further testifies that Exhibit 1007 is a true and correct copy of Verdu as it was published in 1998, as he has access to a physical copy of the text as it was published in 1998. Verdu therefore constitutes prior art under 35 U.S.C. § 102(b). Further, pursuant to FRE § 901(b)(8), Exhibit 1007 qualifies as an “ancient document,” and is, for this additional reason, authentic.

VII. GROUNDS OF REJECTION¹

A. **Ground 1: Claims 1-16 are Rendered Obvious by Onggosanusi in view of Egnor**

Onggosanusi discloses a system for selecting among a plurality of detectors of varying complexity based on a channel estimation of received signals. Onggosanusi further discloses that these detectors output information streams to decoders. Egnor discloses that multi-user detectors can output information streams to a bank of decoders, and it would have been obvious to combine that teaching with Onggosanusi. It also would have been obvious to use Egnor's multi-user detectors, which describe the same algorithms as Onggosanusi's detectors, as well as other well-known components like iterative decoders, interleavers/deinterleavers, and a filter. Ex. 1003, ¶73.

¹ Petitioners are not aware of any secondary considerations of non-obviousness identified by Patent Owner, though none would rise to the level of overcoming the invalidity opinions of Dr. Min. Ex. 1003, ¶¶189-93. Petitioners reserve the right to address any secondary considerations if raised by Patent Owner.

1. Motivation to Combine

(a) Egnor's multi-user detectors

Egnor is directed to a “multiple access processing system for a *plurality of users* employing a *multiuser detector* processing partial blocks of data within a window.” Ex. 1006, Abstract.

As discussed below for limitation 1pre, Onggosanusi describes selecting among multiple MIMO detectors, but also that its system uses multi-user detectors. Ex. 1005, ¶¶3, 6, 19. Alternatively, it also would have been obvious to include multi-user detectors as taught by Egnor in addition to or instead of Onggosanusi's MIMO detectors. Ex. 1003, ¶¶75-76.

A POSITA would have been motivated to do this because a POSITA would have found it desirable to use Onggosanusi's system with multi-user signals such as the multiaccess techniques FDMA, TDMA, or CDMA, thereby increasing the capabilities of Onggosanusi's system. Ex. 1003, ¶77. As Dr. Min explains, “[t]hese techniques are multiaccess techniques that assign different portions of a signal to different users”—for example, FDMA “assigns a different carrier frequency to each users” whereas in CDMA, “[u]sers are assigned different ‘signature waveforms’ or ‘codes.’” Ex. 1003, ¶77; Ex. 1007, 19, 23. Indeed, Onggosanusi itself recognizes that CDMA has “multi-user interference” and that its system is intended to address such problems. Ex. 1005, ¶¶3-6. As Verdu explains, the “object of multiuser

detection” is “the design and analysis of digital demodulation in the presence of multiaccess interference.” Ex. 1007, 26. In other words, as explained by Dr. Min, “[t]he very purpose of multiuser detection is to demodulate a multiaccess signal (such as an FDMA, TDMA, or CDMA signal) in the presence of interference.” Ex. 1003, ¶77. Thus, a POSITA would have been motivated to give effect to Onggosanusi’s instruction for CDMA support by using Egnor’s multi-user detectors.

In addition, a POSITA would have been motivated because Onggosanusi and Egnor both describe similar algorithms for their detectors. Ex. 1003, ¶78. Onggosanusi describes at least three detectors of varying complexity: “joint ML [maximum likelihood] detector,” “linear detectors (LZF/LMMSE),” and “maximum ratio combining (MRC) detector.” Ex. 1005, ¶¶30-34. Egnor also discloses detectors using such algorithms. *See, e.g.*, Ex. 1006, ¶8 (“maximum likelihood joint demodulator”), ¶9 (“various linear algebra based multi-user detectors such as those detailed in the well-known text ‘Multiuser Detection’ by Sergio Verdu”); Ex. 1007, ch. 6.2 (“Minimum Mean-Square Error (MMSE) Linear Multiuser Detection”), p. 77 (“maximal-ratio combining”).

In view of these teachings, a POSITA would have been motivated to use Egnor’s multi-user detectors as the plurality of detectors described in Onggosanusi.

A POSITA would have had a reasonable expectation of success in combining these teachings. Ex. 1003, ¶79. As discussed, Egnor and Onggosanusi disclose that

their detectors use the same algorithms, and therefore would have the same complexity and power requirements. Thus, it would have been a straightforward modification to use multiuser detectors as taught by Egnor in Onggosanusi's system, and a POSITA would have expected Ongossanusi's selection of detectors to operate in a similar fashion, since Egnor's multi-user detectors use the same algorithms with the same complexity and power requirements.

(b) Egnor's bank of decoders

Egnor teaches that it was well known that "[t]he bit streams from [a] MUD [multi-user decoder] are passed to a bank of error correction decoder units 185." Ex. 1006, ¶59; *see also* ¶¶56, 58, Fig. 1. A POSITA would have been motivated to combine Egnor's bank of decoders with Onggosanusi's system for multiple reasons. Ex. 1003, ¶¶80-81.

First, Onggosanusi discloses that the output of a detector is sent to a decoder as a plurality of streams. Ex. 1005, ¶22. Onggosanusi, however, does not expressly teach how its decoder handles each of the streams. Egnor, on the other hand, teaches that a detector's plurality of streams can be decoded using a bank of decoder units, and that this was well known. A POSITA would therefore be motivated to give effect to Onggosanusi's teaching of decoding the streams of a detector by incorporating Egnor's teachings of a bank of decoder units. Ex. 1003, ¶82. In addition, using a bank of decoder units would have been a mere design choice. *Id.*

Second, a POSITA would have been motivated to use a bank of decoders because that would be an efficient method for processing the plurality of streams from Onggosanusi's detectors. Ex. 1003, ¶83. A POSITA would have been aware of the benefits of processing multiple signals in parallel, which would be accomplished by using a bank of decoders, one per each of the plurality of streams. A POSITA would have known this was more efficient and significantly faster than decoding each stream in a series. The benefits of parallel processing had long been known by the filing date of the '492 patent in 2006.

A POSITA would also be motivated by the fact that efficiency and speed were very important and desirable for processing wireless communications. Ex. 1003, ¶84. As wireless communication speeds and bandwidth have increased, it is necessary for the processing of such signals to become more efficient in order to process the increased amount of data in real-time. Because Onggosanusi and Egnor describe detecting and decoding wireless signals containing data, a POSITA would have found it highly desirable to perform such processing as efficiently and quickly as possible in order to maximize bandwidth.

Finally, a POSITA would have had a reasonable expectation of success. Ex. 1003, ¶85. Both Onggosanusi and Egnor describe the same process of detection and then decoding the streams. Indeed, both Onggosanusi and Egnor describe similar, well-known methods of for decoding. For example, both Onggosanusi and Egnor

disclose MAP decoders. Ex. 1005, ¶54; Ex. 1006, ¶59. Both also disclose Viterbi and BCJR decoders. Ex. 1005, ¶62; Ex. 1006, ¶28. These were well-known decoders and Egnor discloses that a bank of decoding units implementing these algorithms was already prior art. Thus, it would have been well-within the skill of a POSITA to implement Onggosanusi's decoder as a bank of decoding units as taught in Egnor, since such implementation was well-known and conventional.

(c) Egnor's iterative decoding

Egnor discloses iterative decoding, specifically, that “[s]oft outputs for each bit of each user from the bank of decoders 185 is ***fed back to the multiuser detector*** 180 for each iteration, one stream of outputs for each interfering user present in the received signal.” Ex. 1006, ¶60. A POSITA would have been motivated to combine Egnor's iterative decoding with Onggosanusi's system for selecting a plurality of detectors. Ex. 1003, ¶¶86-87. In particular, a POSITA would have been motivated to have Egnor's bank of decoders (incorporated as described in the previous section) output their signals to Onggosanusi's detector selector.

A POSITA would have been motivated to allow Onggosanusi's detector selector to receive fed back decoded information because of the well-known benefits of iterative decoding—namely, increased accuracy of decoding. Ex. 1003, ¶88. As Egnor explains, each iteration “produce[s] an improved stream of soft bit (or symbol) decisions that fed into the decoder for another iteration of improvement.”

Ex. 1006, ¶60. A POSITA would be motivated to increase accuracy of decoding because this would allow better accommodation of noisy signals and more reliable reception of such signals. Ex. 1003, ¶88.

Moreover, Onggosanusi also recognized the benefits of iterative decoding, stating that the “***iterative interleaved MAP decoders*** with BCJR or SOVA algorithm using LLRs for each MAP” can “achieve their maximum performance.” Ex. 1005, ¶62. Onggosanusi further discloses “decision-feedback (iterative) detectors, such as iterative ZF, and iterative MMSE.” *Id.*, ¶4. These iterative detectors use a “series of P linear detectors ... with each linear detector followed by a (hard) decision device,” *i.e.* a decoder. *Id.*, ¶26. Thus, a POSITA would understand that Onggosanusi’s iterative detection involves the decoder sending its output as feedback to the detector. Ex. 1003, ¶89.

Egnor further teaches that by using iterative decoding, the process can “continue[] until a desired metric is reached or a fixed number [of iterations] is reached.” Ex. 1006, ¶60. A POSITA would understand that this would provide the benefits setting a “desired metric” as a threshold for performance—allowing the user to perform a trade-off between decoding performance and time, depending on their needs. Ex. 1003, ¶90.

A POSITA would further be motivated to feed back the decoder output to Onggosanusi’s selector. Ex. 1003, ¶91. This would allow Onggosanusi to use its

novel approach of selecting the appropriate detector complexity based on the interference of the improved, decoded signals—allowing the system to gradually choose less complex detectors as the signals are decoded and more decorrelated in each iteration. *Id.* A POSITA would have known this would increase efficiency and power consumption. *Id.*

A POSITA would have had a reasonable expectation of success in implementing Egnor’s iterative decoding into Onggosanusi. Ex. 1003, ¶92. The implementation would merely involve coupling the output of Egnor’s bank of decoder units to the input of Onggosanusi’s detectors and the selector. Egnor already teaches providing the output of the decoding units to Egnor’s multi-user detector—which is instead a selector and a plurality of detectors in Onggosanusi. Such an implementation would have been well-within the capabilities of a POSITA.

(d) Egnor’s interleavers and deinterleavers

Egnor discloses “an interleaver coupled between the multiuser detector processors and the decoders and a deinterleaver coupled between the decoders and the multiuser detector processors.” Egnor, ¶129. Interleavers and deinterleavers were conventional components for signal processing and their benefits were well-known. Indeed, Engnor explains that “Deinterleavers and interleavers ... are used if the transmitted signals are interleaved, such as the CDMA format and are known in the art.” *Id.*, ¶58. A POSITA would have been motivated to incorporate such

components into Onggosanusi because Onggosanusi discloses that its system is directed to receiving and decoding CDMA signals. Ex. 1005, ¶19; Ex. 1003, ¶¶93-95. A POSITA would have understood that in order to give effect to Onggosanusi's teaching of detecting and decoding CDMA signals, interleavers and deinterleavers would be needed in order to process the interleaved CDMA signal. *Id.*

In addition, a POSITA would have been familiar with the benefits of transmitting interleaved signals as well as the need for interleavers and deinterleavers. Ex. 1003, ¶96. Interleavers change the ordering sequence of the encoded bits. By doing this, bursts of errors during transmission are more likely to be evenly distributed in the reordered sequence rather than focused on a single codeword. This increases the probability of decoding / error correction. In view of such known benefits, a POSITA would have been motivated to include interleavers and deinterleavers to support the reception of interleaved signals to increase decoding efficiency.

A POSITA would have also had a reasonable expectation of success. Interleavers and deinterleavers were well-known components and well-within the skill of a POSITA to implement. Ex. 1003, ¶97. It would not have been difficult to follow Egnor's instruction to incorporate interleavers and deinterleavers between the detectors and decoders in order to support conventional, interleaved signals like CDMA.

(e) Egnor's filter

Egnor teaches that “[t]he plurality of signals from each antenna 140 is processed in a RF front end unit [which] provide[s] filtering as is known in the art.” Egnor, ¶53. These filtered signals are sent to the multi-user detector. *Id.*, ¶54. A POSITA would have been motivated to incorporate a filter into Onggosanusi prior to the detector and selector receiving the received signals. Indeed, given the ubiquity of filters (and other conventional components like analog-to-digital converters (ADCs) and digital-to-analog converters (DACs), upconverters, downconverters, and amplifiers) for processing received wireless signals, a POSITA would have read Onggosanusi to include a filter. In any case, filters were conventional and extremely common components that could remove unwanted components like signals of unwanted frequencies. Ex. 1003, ¶¶98-99. A POSITA would have been aware of the benefits of filters and would have been motivated to incorporate Egnor's teachings of a filter to provide a filtered signal to Onggosanusi's selector and detectors. *Id.* A POSITA would be motivated to provide a filtered signal to both the selector and detectors because the selector uses the correlation between the user signals to determine which detector to perform (Ex. 1005, ¶36)—and removing undesirable components would have been known to improve the ability of the selector. *Id.*

A POSITA would have had a reasonable expectation of success because filters were conventional and well-within the capabilities of a POSITA to implement. Ex. 1003, ¶100. A POSITA would have implemented Egnor’s filter by placing a filter between the received signal and the selector and detectors.

(f) Analogous Art

Egnor and Onggosanusi are analogous art to the ’492 patent, because all three are directed to the same field of processing wireless signals. Ex. 1001, 1:20-24 (“This present invention relates to advanced receiver techniques for processing signals, and more particularly to multi-user detection (MUD) for processing multiple users’ signals that interfere with one another.”); Ex. 1005, ¶2 (“The present invention relates to communication systems, and more particularly to multimode detectors and detection methods.”); Ex. 1006, ¶2 (“This present invention relates to advanced receiver techniques for processing signals in a multi-user environment”); Ex. 1003, ¶101.

2. 1pre: A hybrid Multi-User Detector System for processing received signals, comprising:

A hybrid ... System: Onggosanusi discloses a system for selecting among a plurality of multi-user detectors for processing received signals, *i.e. a hybrid multi-user detector system*. Ex. 1003, ¶¶102-03. The ’492 patent characterizes a “hybrid MUD” as a system that “optimizes the MUD algorithms for a balance between computational complexity and performance.” Ex. 1001, 12:54-57. Onggosanusi

discloses a system with “N MIMO detectors having different performance and complexity, where the performance and complexity are *inversely related*.” Ex. 1005, ¶36. Onggosanusi further describes selecting one of the detectors depending on “a channel metric $f(H)$ ” indicating that the channel is “well-behaved” or “ill-conditioned.” *Id.* As a result, the system “use[s] high complexity detectors only when the channel is sufficiently ill-conditioned to require them,” resulting in “a reduction of average computational complexity which translates to (battery-operated) receiver power savings.” *Id.*, ¶40. Thus, Onggosanusi discloses a **hybrid system**.

Multi-User System: Onggosanusi discloses that it is directed to “multimode detectors” that “apply to multiple-input multiple-output (MIMO) systems.” *Id.*, ¶6. While MIMO detectors are not multi-user detectors, Onggosanusi does disclose that its system also can be applied to **signals with multiple users** and therefore a POSITA would understand that its disclosures of detectors include multi-user detectors. Ex. 1003, ¶104. For example, Onggosanusi discloses that its teachings are applicable to “[w]ireless communication systems” that “typically ... have multi-users (such as multiple clients in a wireless LAN),” which results in “multi-user interference” that “requires ... detection methods for interference-limited systems,” such as those disclosed in Onggosanusi. *Id.*, ¶3; *see also* ¶19 (“CDMA ... system having frequency-selective channels which cause MUI (**multi-user interference**)”); *cf.* Ex.

1001, 1:37-40 (“[I]nterference suppression (also called Multi-User Detection or MUD)”). In addition, Onggosanusi discloses that its detectors are “multimode detectors” which a POSITA would understand to include multi-user detectors, not just MIMO detectors. Ex. 1005, Abstract.

Onggosanusi also discloses that the channel estimation matrix H constitutes data for multiple channels, each one being for a separate “data source,” which a POSITA would understand to indicate that the received signal came from multiple sources and therefore multiple users. *Id.*, ¶14; Ex. 1003, ¶1005. Indeed, the received signal has a “number of symbols that are jointly detected as they interfered with one another,” which is a multiuser signal. *Id.*, ¶21; Ex. 1003, ¶1005.

Finally, Onggosanusi discloses that its detectors use several algorithms which are known to be useful in multi-user detectors, including “joint ML [maximum likelihood],” “linear detectors (LZF/LMMSE),” “iterative detectors (IZF/MMSE,)” and “maximum ratio combining (MRC) detector.” Ex. 1003, ¶106; Ex. 1005, ¶30. For example, the well-known text called “Multiuser Detection” devotes an entire chapter to linear MMSE, and also mentions “maximal-ratio combining.” Ex. 1007, ch. 6.2, p. 77. Egnor, which discloses multiuser detectors, also mentions “maximum likelihood joint demodulator” (Ex. 1006, ¶8), and the ’492 patent recognizes “maximum likelihood joint demodulator[s],” “minimum square error” and “zero-

forcing block linear equalizers” as known examples of common components of multiuser detectors. Ex. 1001, 5:26-32.

In addition, Patent Owner has asserted that Petitioner’s MIMO detectors are “multi-user detectors,” and so Onggosanusi discloses “multi-user detectors” under Patent Owner’s apparent construction. Ex. 1008 at 1 (“Multiple data streams are received at the UE from an intracell **SU-MIMO** multi-layer transmission from the same serving cell sector”); *see, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”); Ex. 1003, ¶107.

Alternatively, as discussed above, a POSITA would have found it obvious to combine Egnor with Onggosanusi by including the multi-user detectors as taught by Egnor to achieve the benefits provided by Egnor’s MUDs, including the ability to “comput[e] outputs for each user in one mathematical step” and to take advantage of the “considerable research to address joint demodulation,” especially in view of the fact that Egnor’s multi-user detectors use the same algorithms as Onggosanusi’s MIMO detectors, such as joint maximum likelihood, linear minimum mean-square

error, and maximum ratio combining. See Ex. 1005, ¶¶30-34; Ex. 1006, ¶¶5-6, 8-9; Ex. 1007, ch. 6.2, p. 77; Ex. 1003, ¶108.

Processing received signals: Onggosanusi discloses “preferred embodiment *receivers* employing preferred embodiment detection,” *i.e.* ***processing received signals***. Ex. 1005, ¶12. The “baseband received signal” is a “Q-vector of samples of the received baseband signal (complex numbers) corresponding to a transmission time (interval/block) n ,” *i.e.* ***received signals***. *Id.*, ¶14; Ex. 1003, ¶1009.

$$r = \begin{bmatrix} r_1(n) \\ r_2(n) \\ \vdots \\ r_Q(n) \end{bmatrix}$$

(a) 1a: a parameter estimator coupled to said received signals providing received data information;

Onggosanusi discloses a ***parameter estimator*** that provides a channel estimate H based on ***received signals***. Ex. 1003, ¶¶110-11. Specifically, Onggosanusi discloses a “channel ***estimation***, H ” which can be inputted into a function “ $f(H)$ ” to indicate whether “the channel is ‘well-behaved’” or “ill-conditioned.” Ex. 1005, ¶36. H in particular is “the $Q \times P$ channel matrix of attenuations and phase shifts” of the “baseband ***received signal***” and “may be ***estimated*** using known (pilot) symbols.” *Id.*, ¶14. Onggosanusi further describes that $H = [h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p^{th}

data source to the receiver,” thus disclosing that the estimate is based on ***received signals providing received data information***. *Id.* The channel estimation H is a ***parameter estimate*** because it is based on “parameters for the received raw data” (Ex. 1001, 9:57-58), for example, “pth data source” and “known (pilot) symbols.” Ex. 1005, ¶14. In other words, each row in the channel estimation matrix H corresponds with a parameter estimate of the channel for a particular data source (*e.g.*, user). Ex. 1003, ¶112. This corresponds with the disclosure in U.S. Pat. No. 6,947,505 (Ex. 1010),² which is incorporated by reference into the ’492 patent as a disclosure of known parameter estimators (*see* Ex. 1001, 9:65-10:3) and describes that “[t]he purpose of the parameter estimation unit is to be able to derive channel parameters which uniquely distinguish the characteristics of each individual signal.” Ex. 1010, 1:19-22.

Moreover, the ’492 patent broadly describes parameter estimates to include “any ... information required by the MUD to carry out its processing.” Ex. 1001, 9:64-65. The ’492 patent also states that parameter estimates include “carrier phases” (*id.*, 9:61) which corresponds with Onggosanusi’s disclosure that the

² The ’505 patent is also being asserted against Petitioners by Patent Owner in the parallel litigation, though is not related to the ’492 patent.

channel estimate H is a “channel matrix of attenuations and ***phase shifts***,” with each row being a “channel ... from the pth data source.” Ex. 1005, ¶14; Ex. 1003, ¶113.

Onggosanusi discloses that its “computations can be performed with digital signal processors (DSPs) or general-purpose programmable processors or application specific circuitry (ASICs) or systems on a chip such as both a DSP, ASIC, and RISC processor on the same chip with the RISC processor controlling. Analog-to-digital converters and digital-to-analog converters provide coupling to the real world, and modulators and demodulators (plus antennas for air interfaces) provide coupling for transmission waveforms.” *Id.*, ¶13. Thus, Onggosanusi discloses that the channel estimation is performed using a processor, *i.e.* ***parameter estimator***, coupled to received signals. Ex. 1003, ¶114.

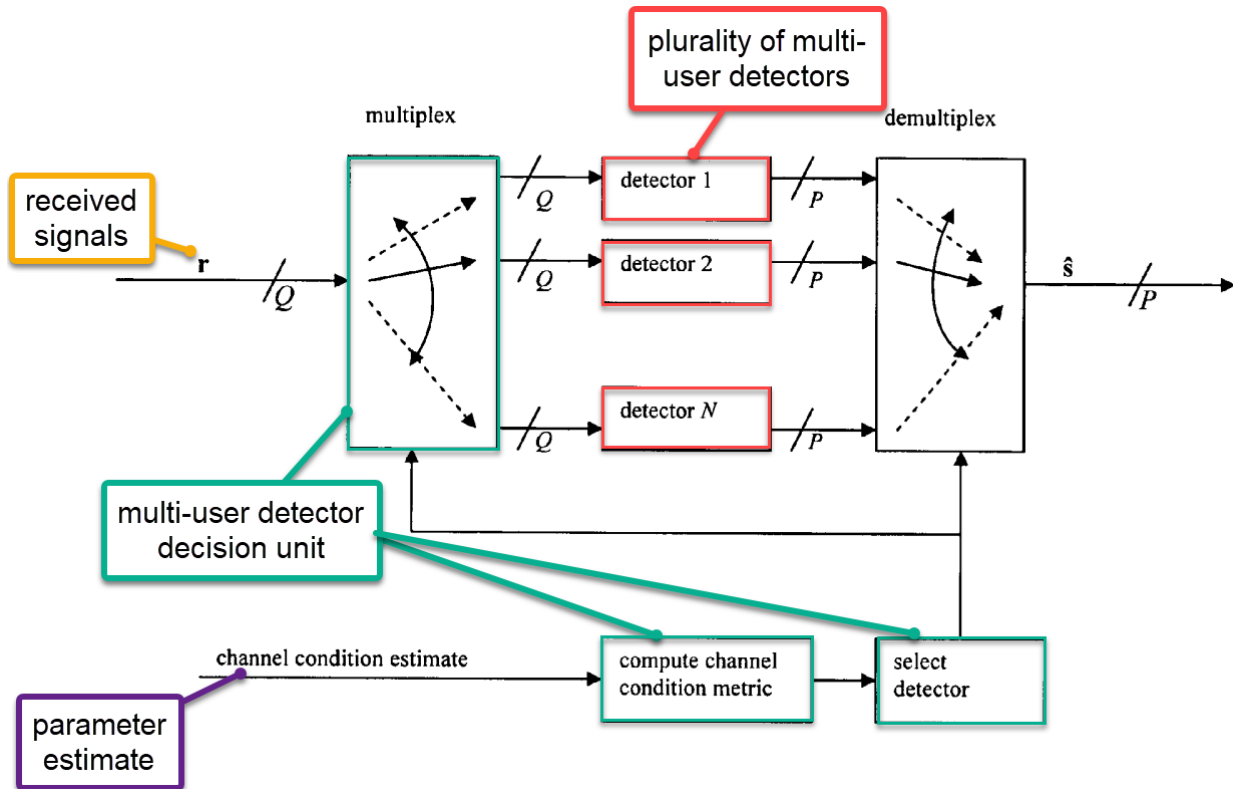
(b) 1b: a multi-user detector decision unit coupled to said parameter estimator and said received signals;

1c: at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit, said multi-user detector decision unit using decision criteria to determine a selected multi-user detector

Onggosanusi discloses using the channel estimation H to select from a number of MIMO detectors of varying complexity and power depending on the correlations in the channel estimate. Ex. 1003, ¶¶115-16.

a multi-user detector decision unit coupled to said parameter estimator and said received signals ... using decision criteria to determine a selected

multi-user detector: Onggosanusi discloses a module that “compute[s] channel condition metric” and “select[s a] detector.” Ex. 1005, Fig. 2 (annotated below). In particular, the “multimode detector” includes multiple “detectors having different performance and complexity” and “[f]or a given channel estimation, H , the *preferred embodiment detector* computes a channel metric $f(H)$, and based on $f(H)$ *selects one of the N detectors* by setting the multiplexer and demultiplexer.” *Id.*, ¶36. The selection of the detector is based on the channel being “well-behaved” or “ill-conditioned,” with “ $f(H)$... partitioned into N regions with each region corresponding to one of the N detectors.” *Id.* As discussed above, a POSITA would have understood or considered it obvious that Onggosanusi’s detectors also can operate on multi-user signals, not just MIMO signals. In other words, the **multi-user detector decision unit** uses $f(H)$, *i.e. decision criteria*, to *determine a selected detector*. Ex. 1003, ¶117.



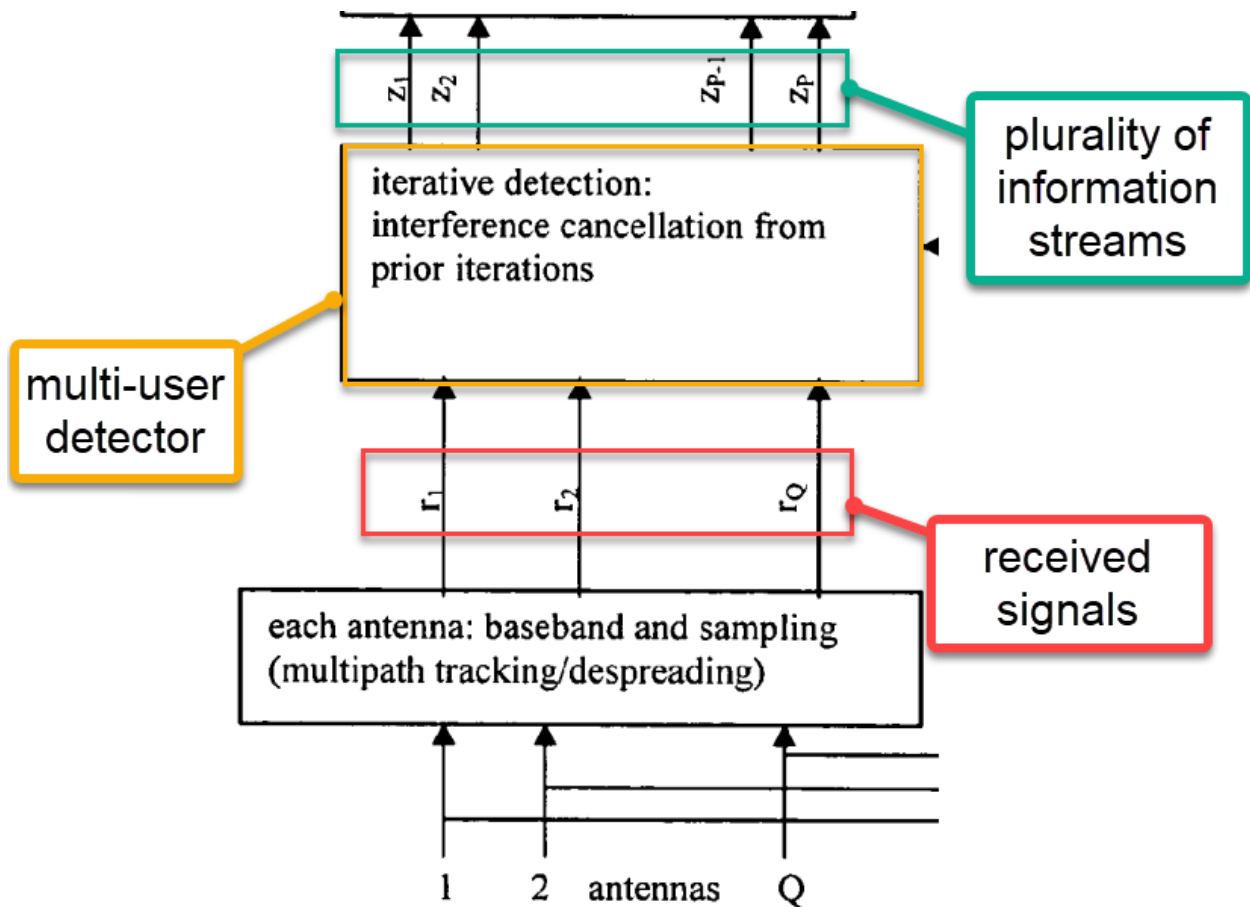
As can be seen, the **multi-user detector decision unit** receives the channel estimate H , and is therefore coupled to the **parameter estimator**. Ex. 1003, ¶118. A POSITA would have known that a conventional “interference-resistant detector[]” utilizes the channel estimate as an input, as seen in Figure 3a of Onggosanusi. Ex. 1005, ¶4. In addition, the multiplexer, which is part of the **multi-user detector decision unit** since it used to “select[] one of the N detectors,” is coupled to “ r ,” which is the Q -dimensional vector of the “baseband received signal,” *i.e.* **received signals**. Ex. 1005, ¶¶14, 36. The **decision unit** is also coupled to the **received signals** via the parameter estimator, which as discussed in limitation 1a, uses the received signals to calculate the channel estimate H .

at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit: Onggosanusi discloses “N MIMO detectors.” Ex. 1005, ¶36. As discussed above, a POSITA would have understood or considered it obvious that Onggosanusi’s detectors also can operate on multi-user signals, not just MIMO signals, and are thus ***at least two multi-user detectors***. Ex. 1003, ¶119. As shown in Figure 2, Onggosanusi’s detectors are ***coupled to the multi-user detector decision unit***. See also Ex. 1005, ¶36 (“[T]he preferred embodiment detector ... selects one of the N detectors”). In addition, the detectors are coupled to the ***parameter estimator*** via the decision unit, which, as discussed above, uses the parameter estimate to select the detector.

(c) **1d: wherein said selected multi-user detector outputs a plurality of information streams, one stream corresponding to each of said received signals; and**

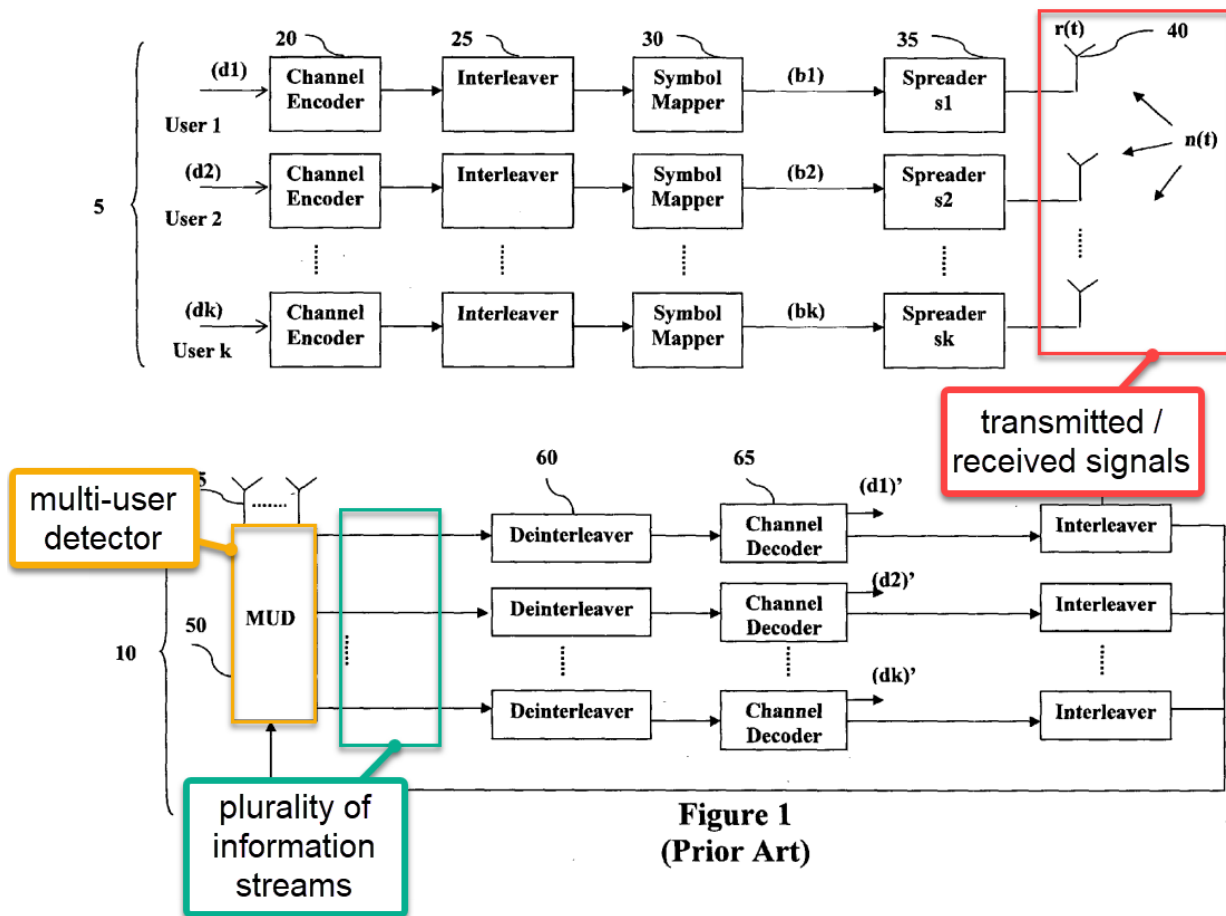
Onggosanusi discloses that each of the detectors “outputs soft estimates z of the transmitted symbols to a demodulator and decoder,” with “ z ” being a vector having a P number of values, *i.e.* ***a plurality of information streams***. Ex. 1005, ¶22. In addition, Onggosanusi discloses that the ***received signals*** “ r ” has a Q number of values, with P being “the number of symbols that are jointly detected as they interfered with one another, and Q is simply the number of collected (spatial and/or temporal) samples at the receiver,” with Q being “as large as P .” *Id.* at ¶21. In other words, Onggosanusi discloses that the number of received signals Q can be equal to

the number of outputted information streams P . Ex. 1003, ¶¶120-21. In addition, Onggosanusi discloses that each decoder uses a $P \times Q$ filter matrix, which converts each received signal to a corresponding information stream. *See id.* at ¶¶23-28. Thus, Onggosanusi discloses that each stream of the plurality of information streams ***corresponds to each of said received signals***. A POSITA would have known that even if the outputs from the N detectors are combined into a serial signal, this serial signal, *i.e.*, the output from demultiplex in Figure 2 of Onggosanusi, contains a plurality of information streams, which are the outputs from the N detectors. Ex. 1003, ¶121. In addition, Onggosanusi explains from a prior art MIMO receiver in Figure 3C, where the detector receives signals r_1 through r_Q and outputs bit streams z_1 through z_P , which are parallel-to-serial converted. *Id.*



This limitation would have also been obvious in view of Egnor. Egnor discloses multi-user detectors that output a plurality of streams corresponding to received signals. Ex. 1003, ¶122. Specifically, Egnor describes that “[v]arious schemes for Turbo MUD [multi-user detector] processing are well known in the art.” Ex. 1006, ¶51. Such detectors receive as input received signals, including “interfering signals” and “outputs a *bit (or symbol) stream associated with each interfering signals* present on the channel for one data block.” *Id.*, ¶¶56, 58. Egnor also depicts in Figure 1 a transmitter transmitting on K antennas and a “MUD” (multi-user detector) that receives “transmitted signals $r(t)$ as well as the various

interfering signals, such as $n(t)$ ” and outputs K number of signals to various decoders. *Id.*, ¶¶49-50. As discussed above, a POSITA would have found it obvious to combine Onggosanusi with Egnor’s teaching of MUDs, which output a separate information stream for each received signal. In addition, a POSITA would have known that when there are multiple K separate decodes available, as in the case of Figure 1 in Egnor, there is no need for the K outputs from MUD 50 to be combined into a serial stream, as the K outputs need to be individually decoded. Ex. 1003, ¶122.



- (d) **1e: a bank of decoders coupled to said plurality of information streams, wherein said decoders output a plurality of improved information streams.**

Onggosanusi discloses that a demodulator and decoder, *i.e. bank of decoders*, decode the information streams to output a plurality of “branch metric values for trellis path searching,” *i.e. improved information streams*. Ex. 1003, ¶¶123-24. In particular, Onggosanusi discloses that “the demodulator ... converts the output P soft symbol estimates [from the detector] $z_1, z_2, \dots, z_p$ [*i.e. information streams*], into (bit-level) conditional probabilities of the transmitted symbols, $s_1, s_2, \dots, s_p$; and a decoder may translate (using a channel model) the conditional probabilities into branch metric values for trellis path searching,” *i.e. improved information streams*. Ex. 1005, ¶54. A POSITA would understand that “branch metric values for trellis path searching” refers to obtaining improved estimates of the transmitted data by traversing a “trellis path” using the “branch metric values” which provide the likelihood of a transition on the trellis path. Ex. 1003, ¶124. A trellis path is a graph that takes every starting state and provides a path for every possible input sequence. The goal is to find the most likely path through the trellis path that represents the transmitted data’s path through the noisy channel to obtain *improved information streams*. *Id.* The most likely path is determined using the “branch metric values” that were calculated by the decoder. *Id.*

While Onggosanusi does not expressly disclose that the decoder is a **bank of decoders**, Egnor discloses that “[t]he bit streams from the MUD 180 are passed to a **bank of error correction decoders unit**.” Ex. 1006, ¶59. Egnor further discloses that “[t]he decoders produce **improved processed blocks of data**.” *Id.*, ¶30; *see also* ¶81 (“The decoder 430 provides **improved data** to each subsequent MUD in the User chain.”). As discussed above, it would have been obvious to combine Onggosanusi with Egnor. Ex. 1003, ¶125.

3. **Claim 2: The System according to claim 1 wherein said plurality of improved information streams are fed back to said multi-user detector decision unit until a final condition is reached and said bank of decoders output a final data stream.**

Egnor discloses iterative decoding, *i.e.* **decoded streams fed back to the detector**, until a desired metric is reached. Ex. 1003, ¶¶126-27. Specifically, Egnor discloses that “[s]oft outputs for each bit of each user from the bank of decoders 185 is **fed back to the multiuser detector** 180 for each iteration, one stream of outputs for each interfering user present in the received signal.” Ex. 1006, ¶60. In combining Egnor with Onggosanusi, the outputs from the bank of decoders 185 in Egnor must be fed back to the corresponding detectors in Onggosanusi. This must be done through the multiplex in Onggosanusi, which is part of the claimed “multi-user detector decision unit.” A POSITA would have known this fact. Ex. 1003, ¶127. This “iterative process continues until a desired metric is reached or a fixed

number is reached” at which point, “estimates of the data sequences for all active users are output.” *Id.*

As discussed above, a POSITA would have combined this teaching with Onggosanusi to provide feedback to Onggosanusi’s detector selector. Ex. 1003, ¶128.

4. **Claim 3: The System according to claim 1 wherein said design criteria is based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.**

It is not clear what “design criteria” is referring to in Claim 3, but to the extent it is referring to the “decision criteria” from Claim 1, this claim is disclosed by Onggosanusi. Ex. 1003, ¶129.

As discussed above for limitation 1b, Onggosanusi discloses using “channel metric $f(H)$ ” to select a multiuser detector. Onggosanusi further discloses that $f(H)$ can use thresholds of a ***correlation matrix between users*** and ***eigendecomposition of correlation matrix***. Ex. 1003, ¶130.

Onggosanusi discloses that “[g]enerally, $f(H)$ is a function of the $Q \times P$ matrix H .” Ex. 1005, ¶36. H is a ***correlation matrix between users***. Specifically, “ $H=[h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p th data source [*i.e. user*] to the receiver.” *Id.*, ¶14. The purpose of $f(H)$ is to determine the “correlations between the $\{h_1 \ h_2 \ \dots \ h_p\}$.” *Id.* at

¶36; *see also* ¶42 (“ $f(H)=MCC(H)$ treats all channel correlations roughly equally, whereas $f(H)=VCC(H)$ emphasizes outliers from the mean, either larger or smaller”). In addition, $f(H)$ is partitioned into “ $N-1$ thresholds ... to define the N regions” for selecting the detector. *Id.*, ¶43; Ex. 1003, ¶131.

Onggosanusi also discloses an example of $f(H)$ that “computes $H^H H$ and finds the eigenvalues of $H^H H$.” *Id.*, ¶41. A POSITA would understand that the calculation of eigenvalues is an *eigendecomposition* of the correlation matrix H . Ex. 1003, ¶132.

5. Claim 4: The System according to claim 3 wherein said threshold is dynamically changeable.

Onggosanusi discloses that the threshold can be *dynamically changed*. Specifically, Onggosanusi discloses that the threshold for “switching between detectors” (rather than initially selecting a detector) “could be subject to hysteresis ... in the sense of the metric must cross the threshold by a minimum amount prior to selecting switching.” Ex. 1005, ¶50. In other words, once a detector is selected, Onggosanusi dynamically changes the threshold to the threshold plus the minimum amount before selecting a different detector. Ex. 1003, ¶¶133-34.

6. **Claim 5: The System according to claim 1 wherein said at least two multiuser detectors are selected from the group consisting of: M-algorithm, sphere decoder, T-algorithm, FANO, reduced state Viterbi, Maximum Likelihood, matched filter, minimum mean squared error (MMSE), decorrelator, and combinations thereof.**

Onggosanusi discloses that its detectors can be “*maximum likelihood* sequence estimation,” “linear minimum squared error (MMSE),” and/or “iterative MMSE.” Ex. 1005, ¶¶4, ¶30; Ex. 1003, ¶¶135-36.

7. **Claim 6: The System according to claim 1, further comprising an interleaver unit and a deinterleaver unit coupled between said bank of decoders and said multi-user detectors.**

Egnor discloses “an interleaver coupled between the multiuser detector processors and the decoders and a deinterleaver coupled between the decoders and the multiuser detector processors.” Ex. 1006, ¶29. As discussed above, it would have been obvious to combine Egnor’s teaching with Onggosanusi. Ex. 1003, ¶¶137-38.

8. **Claim 7: The System according to claim 2, wherein said final condition is determined by one of a fixed number of iterations and an allowable performance level.**

Egnor discloses that the “iterative process continues until a desired metric is reached [*i.e. an allowable performance level*] or a fixed number is reached [*i.e. fixed number of iterations*]” at which point, “estimates of the data sequences for all active users are output.” Ex. 1006, ¶60; Ex. 1003, ¶¶139-140.

9. **Claim 8: The System according to claim 1, further comprising a filter unit coupled to said received signals, wherein said filter unit is coupled to said multi-user detector decision unit.**

Egnor discloses that “[t]he plurality of signals from each antenna 140 [*i.e. received signals*] is processed in a RF front end unit [which] provide[s] *filtering as is known in the art.*” Ex. 1006, ¶53. In Egnor, these signals are sent to the multi-user detector. *Id.*, ¶54. As discussed above, a POSITA would have found it obvious to combine Onggosanusi with Egnor to send the filtered signals to the detector selector, *i.e. multi-user detector decision unit.* Ex. 1003, ¶¶141-42.

10. **Claim 9: The System according to claim 1, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream**

Onggosanusi discloses that “a hard decision decoder just directly converts the soft symbol estimates into hard symbol estimates.” Ex. 1005, ¶54. Thus, Onggosanusi discloses a *hard decision unit*. This is identical to how the ’492 patent describes a “hard decision unit,” wherein “the soft output of decoder 255 is passed to the hard decision unit 270 for processing the hard decisions.” Ex. 1001, 15:53-56. Fig. 3d of Onggosanusi also discloses that the *hard decision unit* is coupled to a decoder and can produce the final data stream $s(i)$. Ex. 1003, ¶¶143-44.

11. **10pre: A hybrid receiver for processing a plurality of received signals, said receiver comprising:**

See 1pre, supra. Ex. 1003, ¶145.

- (a) **10a: a parameter estimation unit coupled to said received signals, wherein said parameter estimation unit extracts received signal information;**

See 1a, *supra*. Ex. 1003, ¶146.

Onggosanusi's parameter estimation unit estimates a channel estimate H from "baseband received signal" "using known (pilot) symbols," *i.e. extracts received signals*. Ex. 1005, ¶14; Ex. 1003, ¶147.

- (b) **10b: a multi-user detector decision unit coupled to said parameter estimator and said received signals, wherein said multi-user detector decision unit selects a multi-user detector based upon at least one threshold;**

See 1b and claim 3, *supra*. Ex. 1003, ¶148.

- (c) **10c: a low complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said low complexity multi-user detector outputs a plurality of low complexity processed information streams;**

10d: a medium complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said medium complexity multi-user detector outputs a plurality of medium complexity processed information streams;

10e: a high complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said high complexity multi-user detector

**outputs a plurality of high complexity processed
information streams; and**

See 1b, 1c and 1d, *supra*. These limitations in claim 1 recite a plurality of multi-user detectors. However, claim 10 specifically identifies three multi-user detectors with each one having its own level of complexity. Ex. 1003, ¶149.

Onggosanusi discloses at least three detectors of varying complexity. Ex. 1003, ¶150. Each detector ***outputs processed information streams*** in accordance with the complexity of that detector. As discussed above for limitation 1pre, a POSITA would have understood or considered it obvious that Onggosanusi's detectors also can operate on multi-user signals, not just MIMO signals—alternatively, a POSITA would have combined Onggosanusi with Egnor to achieve multiple multi-user detectors using the same algorithms disclosed in Onggosanusi. *Id.*

Specifically, Onggosanusi lists four detectors “ranked according to their performance and complexity.” Ex. 1005, ¶30. First, Onggosanusi lists a “joint ML detector: best performance, highest complexity,” *i.e. a high complexity multi-user detector*. Ex. 1005, ¶31. Onggosanusi next lists “iterative detectors (IZF/IMMSE)” and “linear detectors (LZF/LMMSE),” *i.e. a medium complexity multi-user detector*. *Id.*, ¶¶32-33. Finally, Onggosanusi lists a “maximum ratio combining (MRC) detector, ... lowest complexity,” *i.e. a low complexity multi-user detector*. *Id.* at ¶34; Ex. 1003, ¶151.

- (d) **10f: a bank of decoders coupled to said plurality of low complexity processed information streams, said plurality of medium complexity processed information streams, and said plurality of high complexity processed information streams, wherein said decoders output a plurality of refined information streams.**

See 1e, *supra*. A POSITA would understand that the disclosures of improved information streams also provide disclosures of refined information streams. Ex. 1003, ¶152.

12. **Claim 11: The hybrid receiver according to claim 10, further comprising a front end section coupled to said received signals and to said received signal information which filters said received signals.**

See claim 8, *supra*. Ex. 1003, ¶153.

13. **Claim 12: The hybrid receiver according to claim 10, wherein said plurality of refined information streams are fed back to said multi-user detector decision unit for iterative processing until a final condition is reached and said bank of error correction decoders output a final plurality of bit streams.**

See claim 2, *supra*. Ex. 1003, ¶154.

14. **Claim 13: The hybrid receiver according to claim 10, wherein said multi-user detector decision unit makes a selection determined by design criteria based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.**

See claim 3, *supra*. Ex. 1003, ¶155.

- 15. Claim 14: The hybrid receiver according to claim 10, wherein said threshold is changeable.**

See claim 4, *supra*. Ex. 1003, ¶156.

- 16. Claim 15: The hybrid receiver according to claim 12, wherein said final condition is one of a fixed number of iterations and an allowable performance level.**

See claim 7, *supra*. Ex. 1003, ¶157.

- 17. Claim 16: The hybrid receiver according to claim 10, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream.**

See claim 9, *supra*. Ex. 1003, ¶158.

B. Ground 2: Claims 17-18 are Rendered Obvious by Egnor in view of Onggosanusi

Claim 17 is quite different from claim 1. Ex. 1003, ¶159. Claim 17 recites iterative multi-user detection on windows of bits. Specifically, a window of bits in the signal is estimated using a selected multi-user detector, and then the window is incremented and the signal is further estimated. Because of this substantive difference, Petitioner presents this ground using Egnor's windowing method as modified by Onggosanusi's selection of a MUD.

Egnor discloses this a windowing method for pipelining data into a multi-user detector. In particular, Egnor discloses that MUD processes a window of received data, and then processes the next window of received data. Egnor also discloses multiple MUDs. While Egnor does not explicitly disclose selecting between multiple MUDs of varying complexity based on a parameter estimate, as discussed

above in Ground 1, Onggosanusi teaches such claimed behavior. It would have been obvious to combine Egnor with Onggosanusi. Ex. 1003, ¶160.

1. Motivation to Combine

A POSITA would have been motivated to combine Egnor’s pipelined multi-user detection and decoding system with Onggosanusi’s selection of different detectors of varying complexity based on a channel estimation. Ex. 1003, ¶¶161-62.

As discussed in Ground 1, Onggosanusi describes a system for selecting from a plurality of detectors of varying complexities depending on the channel estimate H that estimates the correlation between the received signals. Ex. 1003, ¶162. As Onggosanusi explains, if the signal has low correlation/interference, then a lower complexity detector is suitable—by contrast, if a signal has high correlation/interference, then a higher complexity detector may be necessary. Ex. 1005, ¶¶30-35.

Egnor discloses multi-user detection using conventional methods. Ex. 1003, ¶163. A POSITA would have been motivated to incorporate Onggosanusi’s system for selecting a MIMO detector because of the benefits described in Onggosanusi and known by ordinary artisans. *Id.* As Onggosanusi explains, different types of detectors have different levels of performance and complexity—with higher complexity detectors generally requiring higher amounts of power. Ex. 1005, ¶¶35-38. Onggosanusi generally explains that when a channel is “well-behaved” in that

the signals have “low correlations among the[m],” “then a low complexity detector ... saves computations and thus energy in battery-operated devices.” *Id.*, ¶37. By contrast, if the transmission channel is “ill-conditioned” in that the signals have “a large correlation,” then “a high complexity detector is selected” because “higher performance overcomes channel condition problems.” *Id.*, ¶38.

In other words, Onggosanusi teaches that by selecting among a plurality of detectors of varying complexity, high complexity detectors need only be selected if needed for a noisy channel, whereas less energy-intensive low complexity detectors can be selected when appropriate. Ex. 1003, ¶164. A POSITA would understand that this system provides significant energy savings compared to exclusively using a high complexity detector—and allows for detection of a noisy channel compared to exclusively using a low complexity detector. *Id.* These benefits would have motivated a POSITA to incorporate Onggosanusi’s teachings. *Id.*

Since Egnor discloses a number of MUD processors and decoders in a series (see Fig. 5), a POSITA would have been motivated to incorporate Onggosanusi’s teachings for all the MUD processors. Ex. 1003, ¶165. This would allow the system to gradually use less complex detectors as the signals are processed by subsequent MUD processors that gradually decorrelate the signals. *Id.*

A POSITA would have had a reasonable expectation of success. Ex. 1003, ¶166. Onggosanusi provides implementation details that were well-within the

capabilities of a POSITA. In particular, Onggosanusi explains that its system calculates the channel estimate H , which was well-known. Onggosanusi also provides details as to how its selector uses the channel estimate H : by using one of a number of transformations $f(H)$ and setting thresholds within the $f(H)$, each one mapped to a particular detector. Ex. 1005, ¶¶36-43.

As discussed above for Ground 1, Egnor, Onggosanusi, and the '492 patent are analogous art. Ex. 1003, ¶167.

2. 17pre: A method for processing signals from multiple users with raw digitized data, comprising:

Egnor discloses “Data In” which “represents waveforms from *multiple users* transmitting signals which are received and *processed* by the receiver units.” Ex. 1006, ¶69. Egnor discloses that the received “aggregate signal is collected at the receiver, down-converted and digitized,” which a POSITA would understand to be *raw digitized data*. *Id.*, ¶55; Ex. 1003, ¶¶168-69.

(a) 17a: performing parameter estimation of said raw digitized data;

Egnor discloses that “[t]he MUD processors 410 are coupled to some form of parameter estimator 420 to obtain signal information for processing the data, as well as an interconnection to a priori information.” Ex. 1006, ¶79. Egnor discloses that the parameter estimator “processes the various parameters for the received raw data,” and is generally “known in the art” and “is a broad description for a unit that

provides information to the MUD and decoders such as convolutional code, signatures, multiplexing format.” *Id.*, ¶58; Ex. 1003, ¶¶170-71.

(b) 17b: grabbing a window of bits from said raw digitized data;

Egnor discloses “MUD processors 305 ... has a ‘window’ or frame region 300 in which it processes data.” Ex. 1006, ¶70. The “MUD window 300 processes small chunks of data.” *Id.* The data refers to “received signals from a corresponding plurality of users,” *i.e.* **raw digitized data**. *Id.*, ¶26; *see also id.*, ¶50 (“antennas 45 receive the transmitted signals $r(t)$... [*i.e.*] received signal $r(t)$ for each user.”); Ex. 1003, ¶¶172-73.

(c) 17c: subtracting any known bits from said window of bits;

Egnor discloses that when a user’s block “has already been processed and decoded data,” it will “leave [that data] alone” and instead process and decode another user’s data. Ex. 1006, ¶84. A POSITA would understand that the “already ... decoded data” are known bits, and thus they are excluded from processing. Ex. 1003, ¶¶174-75. Thus, Egnor teaches **subtracting any known bits from said window of bits**.

(d) 17d: selecting a multi-user detector;

See 1c, *supra*.

Onggosanusi discloses selecting between a plurality of multi-user detectors. discloses a module that “compute[s] channel condition metric” and “select[s] a]

detector.” Ex. 1005, Fig. 2 (annotated below). In particular, “[f]or a given channel estimation, H, the ***preferred embodiment detector*** computes a channel metric $f(H)$, and based on $f(H)$ ***selects one of the N detectors*** by setting the multiplexer and demultiplexer.” *Id.*, ¶36. The selection of the detector is based on the channel being “well-behaved” or “ill-conditioned,” with “ $f(H)$... partitioned into N regions with each region corresponding to one of the N detectors.” *Id.*; see also, limitation 1c, *supra*; Ex. 1003, ¶¶176-77.

It would have been obvious to combine Egnor with Onggosanusi’s disclosure of selecting a multi-user detector. Ex. 1003, ¶178.

(e) 17e: estimating unknown bits from said window of bits using said multi-user detector;

Egnor describes that the “partial frame of data” is processed by “MUD₀.” Ex. 1006, ¶80; see Fig. 5. Further, “[u]pon completion of any complete frame, the output from the MUD₀ is an input to the decoding algorithm such as BJCR.” *Id.* Egnor describes that “[t]he information passed from the MUD processors 410 to the decoders 430 encompass the decisions made as part of the MUD processing in establishing the most probable conditional values for the data in the frames,” *i.e.* ***estimating unknown bits from said window of bits***. *Id.*, ¶81. Indeed, a POSITA would understand that the entire purpose of a decoder is to estimate unknown bits. Ex. 1003, ¶¶179-80.

(f) 17f: incrementing to a next window of bits;

Egnor discloses that after a window is processed, a subsequent window is processed. Ex. 1006, ¶73. Specifically, in “a subsequent processing,” a new “processing window 325” is processed by the MUDs. *Id.*, ¶75. In the Figure 5 combination of Egnor, each MUD receives subsequent windows per the description in Figure 4. *Id.*, ¶¶80-81; *see also* ¶79 (“MUD processors 410 are coupled to the *incoming frames* of data 400.”); Ex. 1003, ¶¶181-82.

(g) 17g: repeating said steps of subtracting, selecting, estimating and incrementing until there are no more windows and outputting a set of symbol estimates.

Egnor discloses that as each window is processed and decoded through the plurality of MUDs (which in the combination with Onggosanusi are selected), this occurs “until the last stage at which point the output from the BCJR is the output values of the system, Data Out. The Data Out is the symbol stream of improved and processed data.” Ex. 1006, ¶80; Ex. 1003, ¶¶183-84.

3. Claim 18: The method according to claim 17, wherein said multi-user detector is selectable from the group consisting of high complexity multi-user detectors, medium complexity multi-user detectors, low complexity multi-user detectors and matched filters.

Onggosanusi discloses high complexity, medium complexity, and low complexity multi-user detectors and matched filters. As discussed in Ground 1, a POSITA would have understood or considered it obvious that Onggosanusi’s

detectors also can operate on multi-user signals, not just MIMO signals. Ex. 1003, ¶¶185-86.

Onggosanusi lists four detectors “ranked according to their performance and complexity.” Ex. 1005, ¶30. First, Onggosanusi lists a “joint ML detector: best performance, highest complexity,” *i.e.* **a high complexity multi-user detector**. Ex. 1005, ¶31. Onggosanusi next lists “iterative detectors (IZF/IMMSE)” and “linear detectors (LZF/LMMSE),” *i.e.* **a medium complexity multi-user detector**. *Id.*, ¶¶32-33. Finally, Onggosanusi lists a “maximum ratio combining (MRC) detector, ... lowest complexity,” *i.e.* **a low complexity multi-user detector**. *Id.* at ¶34. As discussed above, it would have been obvious to combine these teachings in Onggosanusi with Egnor. Ex. 1003, ¶187.

Egnor further discloses that the detector can be a “matched filter,” for example, “[t]he input data represents a vector of data, transferred at some rate (e.g., the symbol rate), and this data is typically transmitted to a matched filter.” Ex. 1006, ¶57. Ex. 1003, ¶188.

VIII. DISCRETIONARY DENIAL UNDER *FINTIV* IS NOT WARRANTED

The Board balances six factors in considering discretionary denial under 35 U.S.C. § 314(a) when parallel litigation exists. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). Here, the factors (“*Fintiv* factors”) favor institution.

Factor 1—potential stay of the district court litigation—is neutral because no party has requested a stay. *VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 (P.T.A.B. Aug. 18, 2020), at 17 (finding in the absence of a stay motion that this factor “does not weigh for or against discretionary denial”).

Factor 2—district court trial date and the Board’s statutory deadline—should be considered neutral. Jury selection is not currently set to begin until September 8, 2025 which is a mere five months before the estimated date for the Board’s Final Written Decision. Because much can change in five months, the current trial date does not support denial. *See Dish Network v. Broadband iTV*, IPR2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”). In addition, even if the Board is inclined to weigh this factor in favor of institution, the Board has frequently found that other factors outweigh this factor, especially for a short difference of five months. *T-Mobile USA, Inc. et al. v. Cobblestone Wireless LLC*, IPR2024-00137, Paper 15 (May 15, 2024) (finding an eight-month difference weighs in favor of denial, but that it was outweighed by the compelling merits of the petition).

Factor 3—investment in the district court proceedings—weighs heavily against discretionary denial. The associated district court case is still in the very early stages of litigation: discovery is still in the preliminary stages, the Defendants filed

their invalidity contentions on May 6, 2024, and Claim Construction is not scheduled until March 10, 2025. Thus, a claim construction order will not issue until at least several months after the Board’s estimated institution date. Accordingly, the district court will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution decision. *See Fintiv*, IPR2020-00019, Paper 11 at 9-12. Regardless, Petitioners diligently prepared this Petition and filed over five months before the statutory deadline, which weighs against denying institution.

Factor 4—overlap in the parallel proceedings—favors institution. This Petition challenges many more claims than those being challenged in the parallel litigation. Specifically, Patent Owner is only asserting in the litigation claims 1-3, 5-13, and 15-17 of the ’492 patent, whereas Petitioner challenges claims 1-18 here. Thus, there are issues before the Board that will not be resolved by the district court.

Factor 5—overlapping parties—is neutral as it is “far from an unusual circumstance that a petitioner in *inter partes* review and a defendant in a parallel district court proceeding are the same.” *Sand*, No. IPR2019-01393, Paper 24, at 12-13.

Factor 6—other considerations—weighs against discretionary denial. As explained, the merits of the Petition are strong, and the Challenged Claims are invalid. For example, none of the grounds asserted herein were previously

considered by either the Office or the district courts. *Cf. Comcast Cable Commn's, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not “previously considered by the Office or any court” weigh in favor of not denying institution). Moreover, the '492 Patent is currently asserted in a district court case. Institution of this IPR provides the opportunity for narrowing and simplifying the litigation for the district court.

Compelling Merits – Finally, discretionary denial is not warranted because this petition presents compelling evidence of unpatentability. As discussed above, the '492 patent admits that multi-user detectors of varying complexity were known and that parameter estimation was known. The '492 patent only purports to invent using the parameter estimation to select from a plurality of multi-user detectors. However, Onggosanusi clearly teaches this.

Accordingly, the Board should decline to exercise its discretion under *Fintiv* and institute trial.

IX. MANDATORY NOTICES AND FEES

A. Real Party-In-Interest

The real parties-in-interest for Petitioners are Samsung Electronics America, Inc. and Samsung Electronics Co., Ltd.

B. Related Matters

Collision Communications, Inc. v. Samsung Electronics Co. Ltd et al, 2-23-cv-00587 (EDTX).

C. Counsel and Service Information

Petitioner provides the following counsel and service information.

Petitioner consents to electronic service the email addresses listed in the table below. Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition.

LEAD COUNSEL	BACKUP COUNSEL
James M. Glass (Reg. No. 46729) jimglass@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 51 Madison Avenue, 22 nd Floor New York, NY 10010 Tel: (212) 849-7000 Fax: (212) 849-7100	John T. Mckee (Reg. No. 65,926) johnmckee@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 51 Madison Avenue, 22 nd Floor New York, NY 10010 Tel: (212) 849-7000 Fax: (212) 849-7100 Quincy Lu (Reg. No. 76,954) quincylu@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 1109 First Avenue, Suite 210 Seattle, WA 98101 Tel: (206) 905-7000 Fax: (206) 905-7100 Brian Mack (Reg. No. 57,189) brianmack@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 50 California St., 22 nd Floor San Francisco, CA 94111 Tel : (415) 875-6600 Fax: (415) 875-6700

	Ron Hagiz (<i>pro hac vice</i> forthcoming) ronhagiz@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 51 Madison Avenue, 22nd Floor New York, NY 10010 Tel: (212) 849-7000 Fax: (212) 849-7100 Patrick Stafford (Reg. No. 70,372) patrickstafford@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 1300 I Street NW, Suite 900 Washington, DC 20005 Tel: (202) 538-8000 Fax: (202) 538-8100 Brady Huynh Reg. (No. 77,436) bradyhuynh@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 555 Twin Dolphin Drive, 5th Floor Redwood Shores, CA 94065 Tel: (650) 801-5000 Fax: (650) 801-5100
--	--

D. Payment of Fees

The undersigned authorizes the Office to charge the fee required for this Petition for *Inter Partes* Review to Deposit Account No. 50-5708. Any additional fees that might be due are also authorized.

X. CONCLUSION

For the reasons above, *inter partes* review is requested.

Date: August 1, 2024

Respectfully submitted,

By: /s/ James M. Glass

James M. Glass
QUINN EMANUEL URQUHART
& SULLIVAN, LLP
51 Madison Avenue, 22nd Floor
New York, NY 10010
Tel: (212) 849-7000
Fax: (212) 849-7100

Counsel for Petitioners

**CERTIFICATE OF COMPLIANCE WITH
TYPE-VOLUME LIMITATION, TYPEFACE REQUIREMENTS,
AND TYPE STYLE REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 11,670 words, as counted using the Microsoft Word software that was used to prepare this paper, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman.

Date: August 1, 2024

By: /s/ James M. Glass
James M. Glass
QUINN EMANUEL URQUHART
& SULLIVAN, LLP
51 Madison Avenue, 22nd Floor
New York, NY 10010
Tel: (212) 849-7000
Fax: (212) 849-7100

Counsel for Petitioners

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on August 1, 2024, true and correct copies of the foregoing document and supporting materials were served in its entirety on the Patent Owner at the following address of record as listed on PAIR via Priority Mail Express® or Express Mail:

Official Correspondence Address

Collision Communications, Inc.
20 Depot Street
Suite 2A
Peterborough, NH
UNITED STATES

Courtesy copies were also sent via electronic mail to Patent Owner's counsel of record in the related district court proceeding

ahaley@caldwellcc.com
agras@caldwellcc.com
andrea@wsfirm.com
hhamad@caldwellcc.com
jcassady@caldwellcc.com
acurry@caldwellcc.com
jsummer@caldwellcc.com
jnemunaitis@caldwellcc.com
bcaldwell@caldwellcc.com

Date: August 1, 2024

By: /s/ James M. Glass

James M. Glass
QUINN EMANUEL URQUHART
& SULLIVAN, LLP
51 Madison Avenue, 22nd Floor
New York, NY 10010
Tel: (212) 849-7000
Fax: (212) 849-7100

Counsel for Petitioners